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USEFUL KNOWLEDGE.

THE Presidential Address to the Educational Science Section of the British Association, delivered by Prof. L. C. Miall, was, professedly, an address on "Useful Knowledge"—in reality a discourse at large on education, its methods, subjects and difficulties. On this question it is easy to say much that is true, hard to discover anything new, almost impossible to steer an even course betwixt the rocks of paradox and the yawning gulf of platitude. Prof. Miall's sense of humour saved him from Charybdis; the essential timidity of a British Association audience kept him just clear of Scylla; yet on a hackneyed subject he managed in eleven short pages to talk common sense while avoiding the commonplace, and to interest, without shocking, his audience.

"Useful knowledge," he sardonically remarks, "occupies nearly all the school-time;" this "shows its practical importance, and disposes us to welcome any means of making it more effective." The keynote of the whole paper is the need of cultivating the habit of criticism. "The truly useful knowledge is *mastery*. Mastery does not come by listening while somebody explains; it is the reward of effort . . . . it comes by handling and doing, by contriving and trying, by forming good habits of work, and especially the habit of distinguishing between the things that signify and those that do not." Book knowledge is classed with useful knowledge, but only subject to this condition of criticism; the elder Pliny is held up as a terrible example of the evils of uncritical assimilation. Knowledge is meant for use, and things unused are best forgotten. The memory is not intended to be a storehouse of facts; some are better left in the note book, the dictionary or the card index. Passing to "Science," the professor defines its fascination as the production of verifiable knowledge: its virtues as exactness, impartiality, and candour. This last he explains as "perpetual readiness to revise opinions which are held in respect," a virtue which is too often neglected in these days. "Loyalty, except of one kind, loyalty to herself, science has no use for, and does not cultivate."

Considerable space is devoted to an examination of Herbert Spencer's plea for the universal teaching of science on the ground that it is the knowledge of most worth. The plea is rejected on the double ground that many people have no aptitude for science at all, and that a smattering of many sciences is of little practical value, and may even be a danger. On the other hand, the power of clear and vigorous expression is useful to all, not least to scientific men; and that can only come from the study of language; a study which should be thorough. The chemist or physiologist should get effective command of at least one foreign language, besides knowing enough of mathematics and drawing to be able to make his own calculations and sketches. So, while agreeing with Spencer's estimate of the importance of science, the professor rejects his verdict, with its implication that usefulness is the test by which everyone's

choice should be determined. It was necessary, of course, before a British Association audience to treat with the greatest respect the memory of "our great philosopher," as it was the fashion to call him: but those who can read between the lines will enjoy the neatness of the implied depreciation of his elementary science, and the more outspoken hint of the recoil of his contempt for literature on himself.

About one page is given to scientific training for the medical profession, "our one great scientific profession"—apparently to the exclusion of engineering—which "brings science into the daily life of every one of us." Here, as elsewhere, the professor insists on training rather than knowledge. "The multifarious learning of the text-books should be put aside in order that undivided attention may be given to investigation and proof. . . . I can only hope that the examiners would not expect encyclopædic knowledge." Very little space is given to technical education; yet in a few lines the professor sums it up. Either learn some science or art thoroughly and then work under an expert at its practical application to a particular industry, or else learn the use of particular tools by constant practice and critical examination of failures. The mere acquisition of information about the industry is useless. The information is likely to be taken down inaccurately; it soon becomes obsolete, and it does little to cultivate the intelligence.

Prof. Miall's knack of epigram comes out at its best in the section on Literature, *e.g.*, "Literature and science are incommensurable."—"Rhetoric—which may be fitly described as insincere eloquence." He holds up to deserved ridicule the pedant who says we should be indoctrinated in points of style before we begin to read on our own account, or who makes Shakespeare the text for lectures on grammar, metre, etymology and historical allusions. Elsewhere he touches on the absurdity of learning three or four languages simultaneously, and on the ill-effects of the contest of studies. There is so much to learn, so much which one would be sorry to miss, that there is a poor chance of learning anything thoroughly. So a choice must be made, and the proper criteria of choice are not in the subject but in the learner. These are aptitude and inclination, to which is added opportunity, whether of learning or of exercise in after life. We incline to think that where there is aptitude and inclination opportunity will be found somehow by anyone of any moral grit. Also aptitude nearly always implies inclination, though, unfortunately, the converse does not always hold. Prof. Miall insists also on "the need of steady and impartial government, of drill, in short, if the child is to take all the pains that are indispensably necessary in school work." Under present conditions we agree; but we think this need arises chiefly from the unpalatable nature of school text-books. Teaching in nine cases out of ten tends to destroy aptitude and to stifle inclination. A child goes to school with an insatiable curiosity about the world he lives in, a healthy appetite for knowledge of all kinds, and is fed on offal that any adult would reject with disgust. Opportunity should include access to the best literature on a subject, not the twaddle of the text-book for beginners. We do not pretend that effort is superfluous; but, given aptitude and inclination, reasonable effort will not be wanting. It is the fault of bad teaching that demands an effort, which should be unnecessary, to find the facts under their clumsy presentation.

Lastly, Dr. Miall pleads for leisure for the pupil, has a word of protest against compulsory games, and devotes a short section to Dr. Armstrong's heuristic method. The heuristic method of learning by inquiry and doing has doubtless many advantages, but it has the one defect—that it demands unlimited time, not to say genius, on the part of the learner if he is to carry it out rigidly; *i.e.*, to discover everything for himself. In practice it amounts to gradual teaching: exciting curiosity and then satisfying it by hints, so as to make the pupil think he has discovered the clue for himself. "Try cutting it up into little bits" was such a hint, given by Dr. Hopkinson to his son when struggling with the integration of an area.

We have said enough to show the drift of Dr. Miall's address, and to commend it to the attention of our readers. The inference to be gathered from it is that present methods of education are radically wrong, but he seems to shrink from drawing that inference in its entirety; and to follow out the question raised, even in outline, would more than double the length of this article.

The Arrangement and Uses of Cost Accounts.

The main functions of any system for obtaining the costs of production are:—First, the maintenance of a high efficiency in the factory; secondly, the provision of accurate records for estimating purposes. It is also essential that the results should be actually used, otherwise they tend to become incorrect through lack of interest on the part of those responsible for their upkeep.

To enable cost accounts to be effectually utilised they must be extended to cover the detail costs, and the records must be assembled and indexed in such a manner as to promote easy reference.

The practice of issuing a list of parts with every manufacturing order has now become general, and it is customary to extend one copy for the purpose of recording the costs of production. By introducing suitable columns upon this form, not only can the cost of labour and material upon each item be recorded, but it is quite practicable to detail the weights of different materials. Thus for an electric motor the weights of the brasses, the stampings and other parts would be given separately.

Then, again, columns are reserved for indirect charges, so that these lists give totals and detail costs in every possible form which can be required.

These records are filed under their order numbers, and to make them quickly available for comparing similar orders, indexes are necessary to classify them according to the type and size of product. For estimating purposes more detailed indexing is desirable to enable the prices of various parts to be quickly referred to. Special machines often largely consist of a combination of standard parts belonging to other products, and in estimating the cost it should be much quicker to look up the expenditure on previous orders than to work out the labour and material specially. If, however, the cost accounts are to be depended upon for this purpose, it is absolutely essential that they should be correct, and, as stated above, this feature can only be ensured by frequent use and close supervision on the part of those in control.

The use of the records for comparing the cost of similar orders is, perhaps, more conducive to accuracy than their employment for estimating. If a certain batch of articles or machines cost considerably more or less than similar previous batches, the detail costs should be carefully studied until it is ascertained where the differences have occurred. This process is almost certain to bring to light any errors which exist, and the knowledge that the accounts are used in this way is a strong incentive to the staff to make up the records correctly.

Then, again, the investigation of manufacturing costs has a most beneficial effect upon the behaviour of the foremen, storekeepers and workmen, who soon find that any slackness or inaccuracy is likely to attract the attention of the management through the medium of the cost accounts.

Even in quite small undertakings it will be the rule, in future, to employ a simple system of accounts to ascertain the costs of production, and where such practice has already been established and used in the way we have described, the results have fully justified the extra time involved.

Cable Cars and Law of Negligence.

A CASE which was recently tried in the Court of Session raises certain points of interest in relation to actions for negligence against a tramway company. A small boy was injured by a cable car. His father brought an action against the Edinburgh and District Tramway Co. claiming £2,500 damages. It was alleged that the driver was negligent in not keeping a proper look-out, and that the company were negligent in using a car on which the view of the driver was to some extent obscured by a staircase. The company denied negligence, and alleged that the accident was due to the contributory negligence of the child, and to the negligence of his parents in allowing him to cross the street unattended. The first point of interest is that the case was tried without a jury. It seems that in this matter there is a difference between English and Scotch law. In England, the plaintiff can always insist on trial by jury in cases of negligence; but in Scotland the Court has power to order trial before a Judge alone. The element of sympathy with the plaintiff is thus to a large extent eliminated. In considering the facts of the case, the Judge came to the conclusion that the car was not of faulty construction or design, and that it was going at a reasonable speed. He also held that there was no negligence on the part of the company in not providing a "Tidswell" guard, the use of that apparatus being impossible on a cable car owing to the grip. Of greatest interest, however, is the declaration of law on the question of contributory negligence. "It is not necessary," said his Lordship, "to prove blame on the part of the guardian of a child in order to escape liability. Children will disobey all orders, break all rules and neglect all warnings. But if they do so in such circumstances as the present, the law does not consider that other persons should suffer. . . . . The case is essentially the same as if a grown person, absorbed in a book, were to cross a thoroughfare without looking up or down for approaching cars." This is the law as declared in Scotland. We have no reason to doubt that the same principle would be applied in England.

Water-Power in New Zealand.

ALL those who are interested in the industrial progress of New Zealand, and more particularly those who favour the development of its abundant water-power, will welcome the common-sense decision of its Government to legalise the leasing of such water-power as is required for manufacturing or other purposes. It is curious to reflect on New Zealand, avowedly a progressive State, possessing many growing industries which need cheap power for their successful development, saddling itself with a law retaining the whole of the natural water-power of the country exclusively to the Government, which, as it happens, is utterly unable to develop it, for financial reasons.

State railway electrification has, of course, been more or less discussed in recent times, but even this could scarcely justify such a self-denying ordinance as that in question.

We have the satisfactory evidence of the Governor himself that "from all parts of the country applications come to the State for the leasing of water-power," and thus from an industrial point of view alone the promised amendment is undoubtedly a step in the right direction.

When one remembers the energetic development of Japanese water-powers and the cheap labour which that nation can utilise, it is somewhat surprising that enterprising New Zealanders should have so long neglected one of the prime factors in present-day industrial competition.

Seeing that American and Continental engineering firms have so largely benefited from hydro-electrical work in our own Colonies in the past, the coming opportunity seems to be one which British engineers would do well to utilise while there is yet time.

STEAM TURBINES IN POWER STATIONS.

BY HARRY WEBBER, A.M.I.E.E.

THERE is a tendency all over the country for station engineers and all large firms who produce their own power to adopt steam turbines, and the object of this article is to give a summary of facts in connection with the running and maintenance of steam turbines (Parsons type), which the writer has found by experience to be of the greatest importance.

The most serious trouble met with when first the turbine became something more than a toy, and which is peculiar to this class of prime mover, namely, "the stripping of blades," is practically over. When this does occur it can generally be traced to a bad arrangement of steam piping, allowing a bolt of water to pass over into the turbine, or carelessness about superheat which, if excessive, causes distortion of the casing.

The temperature of the steam should not exceed 550° F., which will give all the usual advantages to be obtained by the use of superheat without any danger in a well-constructed turbine. A good mercury pocket at the steam inlet to the turbine is essential, with a properly protected thermometer kept in continuously, so that the temperature of the steam can be noted at any moment. A sudden rise of temperature from some cause may do the mischief in a very short time.

Another precaution which cannot be too carefully observed, is to prevent any solid matter coming over with the steam. Most makers fit a strainer to their turbines, but as this must have an area equal to that of the main steam pipe, the holes are fairly large, and can only be relied upon to stop small solid pieces of material, which a thoughtless fitter may have left in the steam range when re-making a joint, but other particles do come over with the steam if care is not exercised with the boilers.

An instance I will quote occurred with a turbine which had been running for two years; when it was opened out for inspection, the blading throughout, both in the fixed and moving portions, was found to be badly choked up, some sections of the blades being almost solid. The deposit was of a brown nature, and proved to be boiler composition which had been put in the drums of the Babcock boilers as solid blocks; this was supposed gradually to soften and mix with the water, but evidently some of it came over with the steam. This condition of affairs had not improved the turbine blades, some of which were missing in nearly every expansion, whilst half the last ring at the low-pressure end had entirely gone.

It seems almost incredible that with unshrouded blading, it is possible for blades to come out at the high-pressure end, and find their way through the turbine without causing a complete strip. In this particular instance, I actually found one of the blades lodged in the bottom, and the rotor running at 3,000 R.P.M. must have just cleared this by an exceedingly small amount. At various places it was apparent that blades had been bent over and shifted from their proper angle. Several weeks were spent on cleaning, resetting, &c., but no more solid boiler composition was used.

Good lubrication is of the greatest importance with all high-speed machinery, but with the steam turbine it well repays the user to attain nearly perfect lubrication. This can be achieved by using a good mineral oil, and keeping all trace of water out of it.

Turbine manufacturers have given this matter very special attention, but in a great number of instances they fail to keep all traces of water out. I have had personal experience with three separate turbines that have failed in this respect, and know of a number of others. Two buckets of water could be extracted after eight hours' running in one case, whilst the others were not quite so bad; but the result was the same with all, namely, to cause the oil to emulsify, and throw down a heavy deposit, clogging every part the oil came in contact with.

Water can only get into the oil at two or three places, and will generally be found to proceed either from the steam sealing devices at the ends of the turbine or from the water in the oil-cooling tank. This can easily be located by separating a small quantity of water from the oil, and putting it

through the standard soap test for hardness. Should it prove to be hard water, look to the oil-cooling tank, but if distilled, it must be proceeding from the sealing glands. Sometimes it emanates from both places at once, in which case it will be found best to cure the hard water trouble first. Three months is about the life of oil with a turbine, if water gets mixed with it, but when free from this undesirable mixture the oil will last fully 12 months, and then be good enough for general purposes.

I understand that several well-known oil merchants are putting forward an oil which will stand mixing with water, if the percentage is not great, but this is really only meant for cases where it is impossible to keep water out altogether, notably in marine turbines. It is an attempt to remedy the trouble, but cannot be compared with getting at the root of the evil.

As an instance of how low the oil costs can be kept, take the case of a 3,000-KW. turbine. This requires about 130 gallons of oil to charge it, after a complete clean out. With a good oil which is procurable at 1s. 8d. per gallon, this quantity would last 12 months (providing always that no water gets into it) without a change. Allowing another 50 gallons for leakage, &c., this makes a total of 180 gallons per annum.

Now to reduce this to a given cost per unit generated, assume an average load of two-thirds = 2,000 KW. for ten hours per day, over 200 days per annum, giving 4,000,000 units generated. The cost of oil, being 180 gallons at 1s. 8d., is £15, or ·0009d. per unit generated, being less than 1d. for every 1,000 units generated.

Where turbines are employed to drive alternators of the revolving field type, vibration may be looked for, and it is necessary to keep a close watch during the first few months, as shrinkage of the insulation and other distorting effects due to heat, will tend to throw the rotor out of balance.

At the first sign of increased vibration, it is always best to have the rotor rebalanced. Messrs. Dick, Kerr & Co. do this in a very neat way. The pole shoes have several $\frac{5}{8}$ in. holes drilled right through them, which can be filled either with round sticks of lead, or wood to suit. If it is required to rebalance, it is only necessary to put the rotor on parallel strips and change the wood for lead where desirable, or *vice versa*.

I have known instances where a rotor has, no doubt, been slightly out of balance for some time, and then suddenly become much worse, and caused considerable damage.

There is every reason to anticipate a large demand for "low pressure" or "exhaust steam" turbines, as undoubtedly a great number of really modern and efficient reciprocating engines are in use at the present time, and it is very often preferable to install a low-pressure turbine, to take the exhaust from these, and thus utilise every available pound of steam, than to scrap the engines altogether. Some good examples of this combination are already installed, and give most excellent results, the working pressure of steam being as low as 1 lb. per sq. in. In the writer's opinion, turbines of the Parsons type are most suitable for low pressure work, and in the near future only this form will be used for that purpose. I am given to understand that one or two leading turbine manufacturers are at present considering radical alterations to the design of their high pressure turbines, the result aimed at being the production of a turbine embodying all the best features of the several different types. Whether such a turbine will soon be available depends entirely upon the difficulties which will be met with in the design.

In the matter of governing, the turbine can easily hold its own with the best reciprocating engines on the market.

The direct-acting type is undoubtedly to be preferred, although the original "puff admission" governor enables one to run a turbine more economically when only lightly loaded.

One of the latest governors, which has only just passed the experimental stage, and is of the direct-acting type, has compensating weights, which come in closer to the centre as the main weights themselves move outwards, and *vice versa*, but in practice this proves rather sluggish.

Since the advent of the turbine, specialists on condensing plant have made great efforts to reach an ideal vacuum for any given temperature of inlet water, compatible with barometric conditions.

As an outcome of these investigations, we have the barometric condenser, which, although it has been on the market for a number of years, has not really been brought up to date and pushed to the front till recently. Given a powerful air-pump, with a large exhaust pipe, this plant will maintain an almost perfect vacuum. It has one very great advantage, namely, that no tubes are required, the water meeting the steam in a drum fixed at the top of its barometric leg, whilst the condensed steam and cooling water afterwards fall down by gravity into a tank, from which the circulating water pump is continuously delivering water to the top of cooling towers unless ordinary river water is available. But this very arrangement brings along other features which are detrimental; thus, unless all the water is properly treated, it is obviously impossible to utilise the pure or distilled water resulting from the condensed steam. This water, coming from a steam turbine, has no suspicion of oil with it, and could be pumped direct into the boilers, if from a surface-condensing plant.

The governing feature in settling what type of condenser to adopt will be the quality of water available, as if it would be necessary to treat the water for use with a surface-condensing plant, then softening tanks, &c., would have to be installed, and the other advantages to be obtained with a barometric plant make it unquestionable that the latter is to be preferred.

A point which it is always well to bear in mind with condensing plant for steam turbines, is that, owing to the absence of oil, all iron and steel parts are liable to rust. I have found that steel rings fitted to the buckets of air-pumps rust away very quickly, although the bucket and barrel are both bronze, whereas phosphor-bronze rings last indefinitely. Modern practice with barometric condensers is to use huge light-gauge steel tubes as the main exhaust pipe, and it is here, and in the water head (where a great scouring action takes place) that care must be exercised. In some cases a spare water head is kept ready as a safeguard, but with treated water, such excessive wasting away should not be experienced.

The oil pump of a steam turbine is of as much importance as the governor, and should receive more attention than any other part of the plant. I would almost go so far as to say that it should be in duplicate, so that if one failed, the other could keep up the circulation of oil for some considerable time.

A small hand pump is generally fitted for flushing the bearing before starting up, although in the early Parsons turbines, this was not thought of, even when a very unsatisfactory plunger pump was fitted, with valves liable to go wrong at a moment's notice.

Should an oil pump fail, it takes a very short time to bring about a seizure in the bearings, in fact, it is hardly safe to run long enough to parallel other machines for taking the load. A rotary oil pump of the spur-wheel type contains very little to get out of order, but the method of driving it cannot be too carefully thought out.

It may be as well before concluding, to enumerate some of the most prominent advantages the steam turbine has over the reciprocating engine.

Assuming that an exceptionally good reciprocating steam engine can be turned out new, and everything is perfectly tight, with a steam consumption almost as low as a turbine of equal size, this does not hold good after a few months' steady work, for whereas the turbine will be exactly as at the start, the reciprocating engine will have its piston and valve rings slacker, and the difference in steam consumption will be very pronounced.

Then the cost of oil is much heavier with reciprocating plant, as it seems almost impossible to keep water out of a crank chamber, and cylinder oil is a necessity.

Other items, such as first cost, ground space required, together with repairs and maintenance, will, upon due consideration, show that the turbine holds the field in all of these. In most central stations where the turbine is a recent addition, it has been installed with sufficient capacity to do the work of any three or four reciprocating sets. With such a comparison, the results in total works costs show a 50 per cent. saving on the turbine plant. The comparison is not quite fair to the reciprocating plant, as undoubtedly if the four sets could be converted into one huge engine of

the very best design, the difference would dwindle down to a much smaller percentage.

Turbines are like watches, they are best when kept continuously at work, and the amount of wear and tear is infinitely small. Some doubt seems to exist as to whether they are so reliable as reciprocating plant: personally, I have no doubt on the subject, and would sooner run turbines for this very reason. Providing the various items enumerated in this article are receiving proper attention, the chances of failure are very few, and that familiar figure known as the "greaser" is likely to be eliminated altogether in stations with turbine equipment throughout.

Recent trials by the Admiralty on the new cruiser fitted with turbines, have practically settled the question once for all in connection with marine work, and as a sign that the demand is increasing, the well known Curtis turbine is being built in a horizontal type especially for marine work.

PEAT AND LIGNITE.

Canadian Government Report on their Future.

[CONTRIBUTED.]

Every citizen of the British Empire is in duty bound to take an interest in the peat problem. Our hopes are high that the engineer will succeed in Ireland, where the politician has failed. But for the moment we are more concerned with Britain beyond the seas than with the United Kingdom. What does the Report just issued by the Canadian Department of Mines lead us to expect concerning the peat of that country? This question may be best answered by quoting the following paragraph:—"The increasing population and industrial activity in Canada, demanding every year a larger amount of fuel, the growing scarcity of wood in the settled parts of the country, and the increasing prices of both wood and coal are making the utilisation of our peat bogs a question of great importance." Several other reasons are also mentioned. It appears that the coal deposits in Canada are situated in the east and westerly provinces, leaving the interior provinces practically dependent on the coal mines of the United States. A few years ago there was great anxiety because of the strikes at these mines, and enormous prices had to be paid for fuel.

All of the northern countries possess large areas of peat bogs, and Canada has been liberally dealt with by Nature in that respect. It is estimated that there are nearly 40,000 square miles of peat in the country, and the average depth seems to be about 8 ft. "It is highly probable," says the bulletin of the Geological Survey of Canada, "that these figures are too low, as, up to the present, no systematic investigation of the peat bog has been undertaken, and most likely many bogs have not been recorded and included in the above estimate." In any case, there is an enormous supply of fuel energy waiting to be used, and a certain demand for it if it can be made a marketable commodity.

To the mind of the average electrical engineer, the above figures probably are not easily converted into understandable units. We will therefore at once translate them, and say that, assuming that 1 ton of coal is equivalent to 1·8 tons of air-dried peat, every square mile contains a potential fuel energy equivalent to 430,244 tons of ordinary coal.

At the present time the principal fuel in Canada is wood. But the forests are now required for other purposes—pulp and paper mills, lumber, &c.—and the report states that "peat for fuel purposes is fully comparable, and even superior to wood." In the past, several endeavours have been made to manufacture peat fuel in Canada. Alas! that Canada should have the same story to relate as that of some peat enthusiasts in this country. There have been financial failures, and these have caused a certain distrust among capitalists. But in most cases the attempts have never passed the experimental stage. And this reminds us of the especial value of the report now before us. It contains descriptions of, and facts concerning, peat manufacture in various parts of Europe, where commercial success has been obtained.

There are two main processes of peat briquette manufacture. They are (1) the air-drying method; (2) the mechanical method. The first-mentioned process has been worked with success in Germany and Sweden; but the great future seems to lie with some mechanical process for separating the moisture from the peat. It is obvious that the air-drying method is unsatisfactory for a northern country, for where there is peat there is usually a great deal of moisture and inclement weather. Interesting though the descriptions of many of these air-drying plants are, we must pass on to consider the more advanced ways of treating peat.

The pages which come under the heading of "Manufacture of Briquettes without air-drying the Peat," contain the most interesting matter; for they show that for years the inventor has been trying to introduce artificial means to remove the moisture of the peat, and they contain news which makes us most sanguine. A very long description is given of the Ekenberg wet carbonising process, of which the Report says that it is "the most promising process for the conversion of peat on a large scale into fuel."

Whether this process will be a commercial success in Canada or in Ireland, or whether it will perchance transform the dreary wastes of parts of Russia into useful manufacturing centres, yet remains to be seen; but that the method is of great scientific interest there can be no question. It should be mentioned that the Swedish Government has assisted the inventor with a valuable money grant, and that its expert has reported very favourably indeed upon the process to the Swedish Department of Agriculture. Indeed, most of the information collected upon the subject was originally obtained from that source.

The discovery made by this Swedish doctor is that when wet peat from the bog is heated under pressure at a temperature of 150° C. or more it undergoes a two-fold change.

In the first place, it loses its gelatinous property, and it becomes amorphous. With peat in its natural state it is impossible to remove the moisture by subjecting the peat to pressure. But after it has reached the critical temperature of 150° C., "the larger part of the water in the peat can easily be removed by pressure." That fact is certainly remarkable.

Secondly, a coking action takes place during this process. The amount of carbon in the remaining mass is increased.

Two other interesting points are brought out in the report. One is that no gases are developed. Now, in the dry distillation process large amounts of gases, which contain carbon in some form, are developed. Obviously the amount of carbon in the peat is reduced by such a process. Finally, it may be quoted from the report that "the product obtained can be easily briquetted into solid briquettes after the moisture has been partly pressed out, and the resulting mass is artificially dried. These briquettes do not absorb moisture, and are in appearance and weight very similar to coal, provided that the coking and briquetting are done at a sufficiently high temperature."

A close study of the report leads one to the conclusion that one great point of this new invention is that *no heat is wasted in converting the water contained in the peat into steam before separating it from the peat.* In the other artificial processes this loss by reason of the "latent" heat required has been the source of weakness. The following quotation brings out yet another interesting fact about the resulting fuel:—

"The dried peat obtained contains about 3 per cent. (depending upon the peat used) of a paraffin substance, which, melting at about 90° C., acts as a binding material in the briquettes made. Briquettes containing no moisture can, therefore, be produced from wet carbonised peat if the temperature is kept at 100° C. or more during the briquetting process. Such briquettes have a calorific value of 6,000

calories per kg., or more, weigh about 50 lb. per cb. ft., or more, and contain, therefore, per cb. unit about the same value as ordinary coal."

The report gives the total inclusive cost of briquettes per ton at 8s. 9d., but, although that figure would make the working commercially profitable, it does not seem to have occurred to the inventor or to the author of the report that from peat briquettes sulphate of ammonia may be recovered, as is proposed in the Central Ireland scheme, and is commercially of considerable value.

It is only fair to quote the report upon the matter of other methods which have been employed or suggested. We will take them in order.

Drying by pressure.—The verdict is clear, "The removal of the excess of water by pressing the raw peat has so far not proved successful."

Drying by heat.—"The plants where this method was introduced are, however, closed down several years ago, and probably the economical results are less satisfactory."

Kerrinne's method of drying peat by means of electrical energy.—A plant in which this method was used, and the whole process involved by it, is described, and the following epitaph appears at the end of the description:—"Very little is known of the success of this undertaking, but the briquettes made are in no way superior to common air-dried peat bricks, and the cost of manufacture is naturally considerable higher."

Electro-Peat Coal.—"The name is entirely misleading, as no coking is done by this process," and "the product is not likely to be in any way superior to the common air-dried peat bricks manufactured by the usual methods. It is also questionable if the cost of the electric energy used will be paid back by the small amount of moisture evaporated, and whether the change in the structure of the peat, effected by the passage of the electric current, is as great as claimed."

It is difficult to read thrice through a Government report of 247 pages without catching an enthusiasm for the subject, especially when the matter discussed has been of interest to the reader for some years. Mr. Nystrom, the author of the report, deserves the unstinted praise of practical scientists in this country. The Electrical Review has recently, in a leading article, bestowed great praise upon Mr. Tomlinson's effort to interest the local section of the Institution of Electrical Engineers in Ireland, in the matter of peat utilisation. Captain Sankey will, curiously enough, discuss this very problem of peat in Dublin next week before the British Association. We do not know the views of either Mr. Tomlinson or Captain Sankey upon the conclusions contained in the Canadian report, which we have attempted to set forth above. One so seldom finds encouragement for inventors in reports issued by our own Government, that perhaps one is rendered unduly optimistic by the evident praise bestowed upon one new patented process by the Canadian report. But if we have the altruistic desire to make two blades of grass grow where only one grew previously, or even if we only have the American conception of our great work of civilising—"doing for one dollar what any fool can do for two"—we cannot but hope that some system will be developed to utilise peat in a manner commercially successful. Frail human nature may have a bias for those things with the stamp of authority. A subsidy from the Swedish Government and praise from the Canadian Government report may make the young Swedish inventor of the wet carbonising process suffer from undue elation. We hope not. We can wish for nothing better for Canada, Ireland, Sweden, Norway, Finland, Denmark, Germany, Holland and Eastern Russia than that they will succeed in turning to the use and convenience of man the vast peat deposits which Nature has presented to them, and which mankind, in its ignorance, has for centuries despised.

Mill Struck by Lightning.—During a thunderstorm at Blackburn on Friday last, the Syke Mill, at Belthorn, was struck by lightning. The current travelled down a chimney, entered a weaving shed at one corner and passed along diagonally to the opposite end. The looms were all running, and the beams and healds in eight of them were set on fire. The operatives fortunately had sufficient presence of mind to extinguish the fire.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Lightning Discharges.

The article by Mr. Fernie on lightning discharges, page 314, was very interesting and instructive, and much information might be got from the recorded observations of others given on personal authority and not on hearsay, nor on the assumptions of the lay Press. The present writer remembers the description of the freaks of a thunderstorm which wrecked some farm buildings, as given in the daily papers. It was asserted that a fencing wire which was used for fastening the thatch of a roof was polished bright and cut into small fragments. It was found that although the statement about the polishing was not correct, the havoc was most extraordinary. The wire in question had evidently been raised to an incandescent temperature, and molten into short lengths from 1 in. to 1½ in. long, the ends being rounded, and the whole a beautiful blue colour due to rapid oxidation. The newspaper man who went over the ground first had no difficulty in tracing the direction of the "fluid," as he called it, from point to point until it disappeared into a well. Those who knew less thought it was a disruptive discharge simultaneously splitting a large tree about 100 yards off, and shaking to pieces part of a farm cart, near which was a youth who was instantly killed. During thunderstorms it is quite common to see St. Elmo's fire, a form of brush discharge. An eye-witness to this phenomenon declared that he saw a whole fence on fire. Many observers have stated that they have seen a discharge descend from a cloud into a conductor on a chimney shaft or a church spire. After much observation for many years it cannot be said that any line of direction could be noted. It has never been the misfortune of the writer to see ball or globe lightning, but it is believed that this forms a notable exception to this rule of excessive speed which cannot be followed by the human eye. I can remember a case similar to those given by Mr. Fernie, where a flagstaff on an hotel was split simultaneously with a burn-out on an armature some mile or so distant. It is not necessary to assume that the lightning travelled along the mains for a mile and then burnt the coils. The conditions must be remembered, that in the armature coils at certain points considerable difference of potential exists, but the insulation is quite sufficient to keep matters straight under working conditions, but in the case of oscillations of certain wave-lengths caused by electrical discharges even at remote distances, the insulation breaks down like the coherers in wireless telegraphy. The generating currents themselves do the damage, the lightning flash producing the oscillation which breaks down the electric insulation between the live wires.

Another case is recalled where a fire was raised in a cupboard containing two electricity meters on a three-wire installation. On investigating it was found that a bunch of arc-lamp carbons were stored in a shelf between the meters, resting on both. Here again is the coherer principle at work. A lightning flash, not necessarily near the building, would start a short between the live part of the meter and its case, the carbons shorting over to the other meter, and the "juice" of the supply starting the fire, the lightning flash thus causing the destruction very indirectly.

The most notable instance of this class of phenomenon which the present writer can remember was one when an electric bell started to ring during a thunderstorm. It was near midnight, and the domestics fled from the kitchen when I was sent for. I was strongly advised to fortify myself with something which the lady of the household brought on a tray, "before you go down," she said, "in the darkness." The battery was disconnected after a note had been taken of what room the lightning had been at work in, as shown on the indicator. Then silence was restored. A very casual observation next day revealed the following:—A pear push and flexible were used to reach the dining table, to be used only at meals. This was branched off a rosette on the wall, and the flex was roughly coiled up and

hung on a hook. At some period of its history some of the domestics had coiled up the flexible and carelessly allowed it to come near a gas flame, which scorched the insulation, leaving only a charred material between the live wires. Here, then, at this point was a condition which only waited for an electric wave to cause coherence of the strands of the flexible and alarm the household. No amount of coaxing would induce a rehearsal, although it was evident that the alarm was one of Nature's wireless bell-ringing. There is much yet to be learned on the subject which is full of interest. The present summer, with more than the usual amount of sultry days, has been very immune from thunderstorms, and conversely some years of cold raw summers have seen more than an average of these thunderstorms.

Those who have been eye-witnesses of ball lightning might describe its appearance and some of its effects.

Alexander Spark.

Aberdeen, *August 29th*, 1908.

Auto-Transformer Installations.

I should be very glad if any of your readers, preferably contractors, who have had experience of the working of auto-transformers or balancers in connection with metallic-filament lamps of low candle-power and voltage, would give some details of their experience with these. Do they, in actual practice, effect the economies claimed for them, and are they received with favour by consumers? Are your readers of opinion that they are likely to become the usual practice, on alternating circuits, or not? There seems to be a sharp difference of opinion in the electrical world regarding these, and it would seem that some accounts of actual experience would be worth perusal, and might settle the matter as to whether their installation is, or is not, advisable.

G. Clifton.

[There is no doubt about the practicability of the system, and a great number of such installations have been successfully carried out. We shall be glad to hear from readers who have had experience in this connection.—EDS. E.R.]

Municipal Extravagance.

I think the following extract from a corporation specification is a good example of the way the ratepayers' money is wasted :—

> The price to include . . . . . and the necessary cables from these switches to the switchboard, which must be cleated up in the cable trench shown on our drawing, in an approved manner to the electrical engineer.

Why cannot the cables be cleated up to a boy? If the engineer is used, I imagine he will be bound to neglect his other duties.

Municipal Reformer.

The Electrical Industry.

"Socialist" has quite distorted my letter on the above subject. My policy, which was most clearly stated, is not to call in money indiscriminately, as I am quite aware that very few businesses can be carried on without credit. However, in my opinion, unlimited and lengthy credit is as great an evil as no credit, and my policy is to strictly limit the length of this credit. Does, for instance, "Socialist," in his private capacity, buy goods for which he knows he cannot pay in less than six months? If so, I am sorry for him; and in the same way I am of the opinion that trading firms should not order goods for which they know they will not be able to pay in less than six months or so. As a matter of fact, some of the larger firms are taking up a much firmer standing regarding the length of credit they will give; and if this policy of more strictly enforcing the usual trade terms is gradually adopted, then it will be for the good of the industry.

Unfortunately, I am not a millionaire, and, fortunately, I am not a Socialist, but I certainly think that the custom of giving six or eight months' credit tends largely to over-trading, cut prices, and a good number of the failures; and I should welcome the policy of more strictly enforcing the usual trade terms both on the credit and debit side, and believe that it would be to the considerable advantage of the industry. Even in the case of large contracts, payments are made to the contractor as the work progresses, and these payments, together with a certain proportion of capital which the contractor should have, should enable the contractor to pay out in accordance with the terms stated in my previous letter.

Richard C. Dieppe, A.M.I.E.E.

London, S.W., *August 28th*, 1908.

I duly read "Innocens's" article in your last issue, entitled "Tangled Topics," and whilst thanking him for his kindly reference to myself, would suggest that he and some other of your correspondents have not yet grasped the objects of the proposed Electrical League. He assumes that the League is formed to remove all causes of dispute between the different sections of the industry, and make everyone obey its behests to that end. This is not so. It cannot be denied that the electrical industry is suffering from keen depression, and the suggested League would consider the various reasons for this, and then set to work to apply such remedies *as lie within its power*.

The industry is hampered by legislative restrictions. Is it so foolish to make a united effort to remove the obstacles? We suffer from depression, because demand does not grow quickly enough. Is it quite impossible to educate the public to the advantages of electricity by an energetic publicity campaign carried out by the whole industry for the whole industry? Is it not probable that in many other directions united efforts would improve the position? These are pertinent questions, and not lightly to be answered in the negative.

There is hardly an industry in the country of which the members are not bonded in close union in matters of general welfare, though keenly competing in other respects. Before we sit down and say we are incapable of doing what others have done, let us at least see whether we are really so feeble.

R. Borlase Matthews, Wh.Ex., A.M.I.C.E.

London, S.W., *August 29th*, 1908.

A Freak Motor Wanted.

May I, through the medium of your paper, ask if any reader of the ELECTRICAL REVIEW will kindly furnish me with the name of a firm or firms who can supply a motor to work under the following stringent conditions, viz. :—

1. Its H.P. at all speeds must be equal to 15.
2. Its minimum speed = 75 R.P.M. in positive direction.
3. Its maximum speed = 750 R.P.M. (in + direction).
4. It must be able to work at any intermediate speed by means of special controller and field regulating devices.
5. It must be able to reverse from any speed in + direction, to 1,500 R.P.M. in a negative in as short a period as possible.

A very good price will be paid to any enterprising firm who can produce such a motor.

Enquirer.

Metal-Filament Lamps.

Referring to "Contractor's" letter, I should like to state that I have had a considerable number of Osram lamps through my hands, and my experience invariably is that if they are purchased as packed in the original casks they arrive intact. On the other hand, if they are purchased a few at a time and packed in ordinary packing cases, breakages do occur. This, of course, points to the necessity of very careful handling when they reach "Contractor's" hands.

I should very much like to know what other troubles "Contractor" refers to. I have certainly obtained very satisfactory results with Osram lamps. The very first batch I obtained over 18 months ago were not so satisfactory, a

small percentage blackening very rapidly, but on my drawing the attention of the suppliers to the matter, they replaced the defective lamps free of charge. Since that time there has been no cause for complaint. I may mention that we have here 50 posts which were fitted with Osram lamps nearly a year ago; they have been burning over 2,000 hours without a single failure, and we are now fitting Osram lamps throughout.

Now comes *my* grumble. When our representative approaches a gas consumer with a view to securing him as a customer he gets along very nicely until the question of cost of installation comes up. The price of the Osram lamp then has to come out, and the mention of 4s. per lamp often frightens the would-be consumer, who generally retorts that "he can purchase gas mantles at 4d. each."

I hope that when the present rush is over, metallic-filament lamp makers will see their way to place a good lamp on the market for about 2s. It is the small fry we want to catch, and a four-shilling lamp will not do it.

The lamp maker cheerfully tells the station engineer that what we lose at present we shall make up in the future, but, unfortunately, he acts contrary to his own advice!

Wm. J. U. Sowter.

Electric Lighting Station, Bray.
August 31st, 1908.

Condenser Action of Synchronous Motors.

In an article in your issue of August 21st, "M. G. M." spoke of calculating graphically the rating of a synchronous motor for improving the power-factor of a generator supplying an inductive load, but he did not explain very clearly the graphical construction required. Perhaps, therefore, I may be permitted to supplement his article by giving a simple graphical method of working out the results in question.

For rough calculations, it is often sufficiently accurate to plot a vector diagram on squared paper, and to scale off the results from the diagram, thus entirely avoiding the necessity for any arithmetic, and in such cases the graphical method is very convenient.

To illustrate the method, I give below the graphical constructions in the same three examples as were given by "M. G. M." In the figures, the abscissæ, measured along O X, represent true kilowatts, and the ordinates represent the wattless components.

Example I.—1,500-K.V.A. set working at 70 per cent. power-factor. Required to find rating of synchronous motor to bring power-factor up to unity, power-factor of motor being taken as 5 per cent.

In. fig. 1, set off O A to represent a round figure in KW. on the scale adopted; in this case 1,000 KW. will be a convenient amount. Strike the circle A B with O as centre. Set off

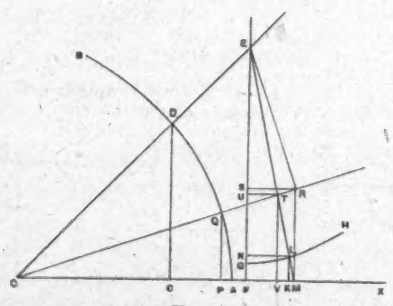


Fig. 1.

O C = 700 KW., and set up a perpendicular at C cutting circle A B at D. Then O D represents, vectorially, K.V.A. at 70 per cent. power factor. Set off O E = 1,500 K.V.A., and drop E F perpendicular to O X.

Then O E = K.V.A. output of generator.
O F = true KW. output.
F E = wattless component.

To bring power factor up to unity, set off E G = say, 1,000 KW., strike circle G H with E as centre, set off F K = 50 KW. (= 5 per cent. of E G), set up perpendicular at K cutting circle G H at L, join E L and produce to cut O X at M. Then E M represents, vectorially, the K.V.A of motor, for

$$\frac{FM}{EM} = \frac{NL}{EL} = \frac{FK}{EG} = \frac{50}{1{,}000} = 5 \text{ per cent.}$$

(For such a low power factor as 5 per cent., all this construction is really hardly necessary, and it would be sufficiently accurate simply to set off F M = $\frac{1}{20}$th of E F.)

Then E M = K.V.A. rating of motor.
F M = true KW. input to motor.
O M = total true KW. output of generator.

Example II.—Power factor of generator to be raised to 95 per cent. only, true KW. input of synchronous motor remaining the same as before.

In fig. 1, set off O P = 950 KW., and set up perpendicular at P cutting circle A B at Q. Then O Q represents, vectorially, K.V.A. at 95 per cent. power factor. At M set up a perpendicular cutting O Q at R, and draw R S parallel to O X.

Then E R = K.V.A. rating of motor.
S R = F M = true KW. input to motor.
E S = wattless component of motor.
$\frac{SR}{ER}$ = power-factor of motor.
O R = K.V.A. output of generator.
O M = true KW. output of generator (as before).
M R = wattless component of generator output.

If, instead of keeping the true KW. input of the synchronous motor the same as in the first example, as "M. G. M." did, we were to keep its power factor the same as before, namely, 5 per cent., as would more probably be done, then—

E T = K.V.A rating of motor.
U T = true KW. input to motor.
E U = wattless component of motor.
O T = K.V.A. output of generator.
O V = true KW. output of generator.
V T = wattless component of generator output.

Example III.—400-K.V.A. set working at full load at 70 per cent. power factor; this is to be raised to 95 per cent. by means of an over-excited synchronous motor, which is also to give out all the mechanical power possible without over-loading the generator.

Proceed as before, making O A (in fig. 2) = say, 500 KW., and O C = 350 KW. Set off O E = 400 K.V.A., and drop E F perpendicular to O X; then O F = true KW. output of

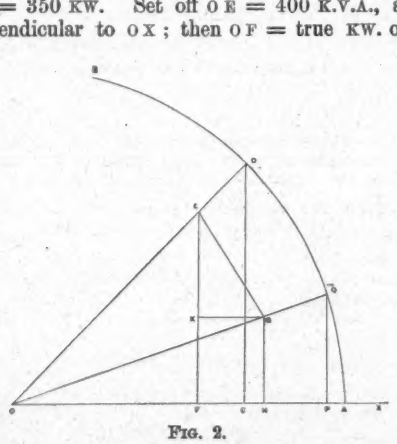


Fig. 2.

generator at full load with 70 per cent. power factor. Now set off O P = 475 KW., and draw P Q and O Q as before, so that O Q represents, vectorially, K.V.A. at 95 per cent. power factor. Set off O G = O E, and drop G H perpendicular to O X. Then E G = K.V.A. rating of motor.
K G = F H = true KW. input to motor.
F H = motor losses = mechanical power obtainable from motor.
O G = K.V.A. output of generator = 400 K.V.A.
O H = true KW. output of generator at 95 per cent. power factor.
E K = wattless component of motor.
H G = wattless component of generator.
$\frac{KG}{EG}$ = power-factor of motor.

The object of making O A a round number of kilowatts is, of course, to avoid the necessity of arithmetic in calculating O C and O P. In the particular instance given in Example II, it would have been simpler to have made O A = 400 KW., but the figure has been drawn as it is in order to make it more general.

The above examples will sufficiently illustrate the method, which is a very simple one, and can easily be applied to any required case in a similar manner.

G. C. Allingham.

August 31st, 1908.

British Trade with Russia.

Your leader in last Friday's issue of your valuable paper has interested me very much, as it touched on a matter which I have in vain discussed for years, viz., the absence of English travellers on the Continent, and particularly in Russia, where, as you say, an enormous amount of business is to be done, which I can fully endorse from experience. My opinion is that manufacturers are afraid of both expense and success, because where they did send travellers out they usually made a muddle of it. They were not sufficiently accommodating to the Russians and never studied their tastes and requirements; they wanted to sell from stock, and would not make what the Russians wanted and asked for. Alterations suggested, which might have led to business, were rejected with the remark, "We can't do that; you must buy what we make." The result was that the order went to Germany, where it was gratefully received and executed according to the buyer's wishes. I will not say that this refers in any way to the electrical trade, but it certainly refers to a good many others, and it ruined business from the beginning. But to the point, the greatest enemy, to my idea, to foreign trade is our lack of enterprise, push, and, as already mentioned, dread of expenditure. The spirit of venture has fled from England for years, and speculation is dead. Money is not to be had for anything, good or bad, the best commercial patents are lost for the want of capital to exploit them. This has gone so far that patentees, who know their way about, go first to France and Germany, were they stand a better chance of obtaining cash and assistance than here, and when their invention is finally manufactured abroad and exported to England, showing large profits, they generally find a buyer here also, but seldom before. The fact is, capitalists want to be sure of their profits before they invest, and manufacturers waste too much time going ahead, and by the time their mind is made up, others have done the job. Take flame arc lamps, for example. The first lamps came over here in 1901, and they were imported regularly for years before our manufacturers could be induced to make them themselves.

I expect to go to Russia on business at an early opportunity, and if your leader produces any good results, I am open to assist any firm that wishes to benefit by your advice. I enclose my card.

Traveller.

London, E.C.,
September 1st, 1908.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"Power" writes:—"We have premises in a place where the Borough Council supply electricity. We have a cinematograph arc lamp taking 60 volts, whereas our supply is 240, necessitating our throwing away 180 volts. To obviate this waste we proposed using a motor-generator, this being agreed by the borough engineer as being advisable; but, on doing this, we claim to be supplied at power rate, but he refuses to supply us other than on lighting rate. In case there may be anything in the point that a motor-generator takes current and converts it into light automatically, we should be prepared to put in a motor pure and simple, afterwards coupling it up to a dynamo when we should probably not only transform the current for the arc, but utilise it for our lighting throughout. We understand there are several precedents created by High Court decisions on the point as to whether a borough or supply company has the right to dictate to a customer applying for power how he shall apply that power when taken, our point being that, if we install a motor, the borough is bound to supply us with energy (under the non-preferential proviso) at the same rate at which they supply energy to other power consumers, and that they have no right to say what we shall do or shall not do with that energy and that we are at equal liberty to drive a dynamo or generator as shafting, wood-working or printing machinery or anything else. We understand that the borough concerned holds its powers under the 1882 Act, not the later one, and we have been told that in Manchester, where the corporation refused to allow a motor-generator to be used, a motor was put down, and they were compelled to supply power to this, though knowing that it would be (and was) used to drive a dynamo to produce light."

*** This question has been addressed to the "Legal Query Column" before now. There is no reported case on the subject; and it can only be answered after careful consideration of the principles which underlie the Electric Lighting Acts. What "Power" wishes to do, is, in effect, to use electricity supplied at power rates for lighting purposes. Every supply authority is allowed by Parliament to make certain charges for electricity. In modern provisional orders, a maximum charge is inserted for power and another maximum for light. It is manifest that the supply authority can afford to supply for power at cheap rates, because a motor will, as a rule, be run during the day, and so help to prevent the plant at the generating station being idle. Now it is obvious that if one consumer was entitled to use a motor-generator, the same privilege might be enjoyed by every consumer in the district. Take, for instance, the case of a large consumer, using 1,000 lights every evening from 6 to 12. It is obvious that he would soon recover the expense of installing a motor-generator by reason of the reduction of his meter rent. The view hitherto expressed in this column—from which there does not appear to be any reason to depart—is that the use of a motor-generator for this purpose would be a colourable evasion of the Electric Lighting Acts; and that where current is used, through a motor-generator, for lighting purposes, the authority are entitled to make a full charge.

MANCHESTER ELECTRICAL EXHIBITION.

The following is a supplementary list of firms who have applied for space at the above Exhibition, since the making up of the list published in our issue of August 21st:—

Abbey Electric Co., 17, Victoria Street, S.W.
Automatic Machine Co., Collier Street Works, Salford.
Bateman Machine Tool Co., Balm Road, Hunslet, Leeds.
Birch, G., & Co., Ltd., engineers, Manchester.
Bell Rock Belting Co., 24, Gravel Lane, Salford.
Bate, C. D., & Co., 40, Brazennose Street, Manchester.
Brayshaw, Ltd., engineers, Manchester.
Birch, J., & Sons, 3, London Wall Buildings, London.
British Thomson-Houston Co., Ltd., Rugby.
Blackman Ventilating Co., London.
Combination Metallic Packing Co., Hillgate, Gateshead-on-Tyne.
Dowsing Radiant Heat Co., Ltd., 24, Budge Row, London.
Elkington, Ltd., 22, Regent Street, London.
Electrelle, Ltd., Spring Gardens, Manchester.
Electric Rifle Co., Shaftesbury Avenue, London.
Fittings, Ltd., 112, Victoria Street, London.
Griffin, J. J., & Son, Kingsway, London.
Harper Electric Piano Co., Holloway Road, London.
Hughes & Stirling, Ltd., Liverpool.
Luke, H., Ltd., Brazennose Street, Manchester.
Marples, Leach & Co., London.
Mawdsley's, Ltd., 25, Victoria Street, London.
Mealy, T. H., 87, Stovel Avenue, Manchester.
McPhail & Simpson, Ltd., engineers, Wakefield.
Noyes, C. J., Pendleton, Manchester.
Phillips, J. W., 23, College Hill, London.
Phillipson & Co., Holland Street, Astley Bridge, Bolton.
Small & Parkes, Ltd., Manchester.
Triumph Stoker, Ltd., Leeds.
Thornton, A. G., & Co., Ltd., Paragon Works, Manchester.
Vincit, Ltd., Victoria Street, London.
Vulcan Boiler Insurance Co., Ltd., King Street, Manchester.
Wellman-Seaver & Head, Ltd., Victoria Street, London.
Wright, A., & Co., Ltd., Westminster Palace Gardens, London.

The above names bring up the total number of exhibitors to more than 230—a very gratifying result for a Trade Exhibition.

It was with surprise that we, as exhibitors, received last week a notice from a certain advertising agency, informing us that the "valuable space" above our own stand, and extending down some 5 ft. from the roof decorations, was to let for the purpose of a large sign or advertisement. The price was to be so much, and the agency were prepared to make and fix the sign for a further specified figure; if we did not reply by a date that was named, the space would be let to someone else, in more senses than one, over our heads. Nobody will object to every reasonable effort being made to produce revenue in connection with so costly an undertaking,

but the quite unreasonable nature of the proposal referred to, as well as the uncouth terms in which it was couched, compelled us to offer a protest. We are pleased to learn, in reply, that the circular was sent out without the knowledge or consent of the management, and that it has therefore been withdrawn. Exhibitors may, by arrangement, avail themselves of the space above their stands, but if they do not do so, the position will not be utilised.

ELECTRIC PYROMETRY.

THE determination of temperature in furnaces, combustion chambers and similar places exposed to extreme heat, has proved a very favourable field for the application of electrical measurements, and the enormous utility of such instruments as Dr. Callander's electrical pyrometer in the investigation of thermal phenomena affecting research work in electro-chemistry, iron and steel processes,

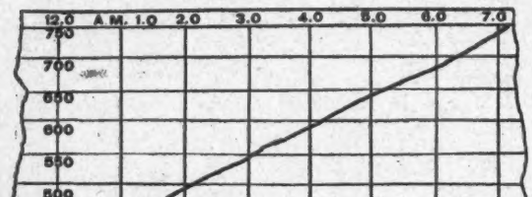


FIG. 1.

and similar operations, cannot be over-estimated. For ordinary metallurgical work, however, where it is not necessary to carefully and continuously observe the effect of some particular combination of time and degree of heat, it is evident that the method of tracing a continuous curve is in practice unnecessary.

In order to obtain a continuous line or record, similar to that shown in fig. 1, a large number of costly and unnecessary complications and refinements are introduced into the recording apparatus, and the use of the resistance thermometer, as introduced by Siemens, is essential. This, however, is always troublesome where long continued work is required, and the batteries energising the circuits become rapidly exhausted.

In order to secure simplicity and moderate cost in commercial pyrometric apparatus, it is obvious that, by the elimination of the continuous record and the substitution of a time-temperature chart showing only the maximum and minimum heats, a simplification has been effected which is quite sufficient to ensure that proper

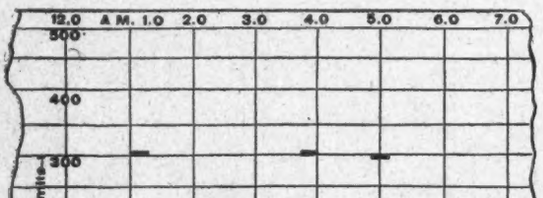


FIG. 2.

supervision of the furnace has been given by the men in charge, in order to keep the heat within the proper limits. Mr. W. Armour, of Irvine, N.B., recently patented a pyrometer of this commercial description, which gives a "curve" somewhat as shown in fig. 2. Assuming that the limits at which the meter has to work are predetermined as a minimum 200° and maximum 300°, the times at which temperatures reach a limit in either direction are marked by short dashes on the chart. The apparatus can be controlled by a simple thermo-couple, and the meter can be made adjustable to any desired degree of temperatures.

A very useful appliance in connection with this pyrometer is the provision of an automatic alarm which comes into action immediately either degree of heat (either too low or too high) has been reached. In practice it has been found that the functioning of the instrument under thermo-electric control is quite sufficiently accurate for all necessities of every-day operation. The men in charge of any particular process have positively no excuse for violating their instructions, as the meter can be read at any time, and, in addition, the alarm always comes into action should there be the least carelessness.

As an example of the possible range of usefulness of these instruments, two have recently been completed by Messrs. Kelvin and White, of Glasgow, one for a very delicate purpose having a range of 150° C. only, the other being for the high temperature of 1,600° C. The apparatus also proves itself of value for iron and steel works, potteries, chemical works, explosive works and similar uses.

COST OF ELECTRIC POWER FOR GRAVING DOCKS.

IN the course of Mr. Snell's paper on the cost of electric power for industrial purposes, which was read at the beginning of this year before the Institution of Electrical Engineers, it will be remembered that two cases from actual practice were quoted in order to compare the cost of gas and electricity for this purpose. The first one was that of an electrically-driven pontoon capable of berthing a vessel up to nearly 4,000 tons displacement. On an official test, when docking a vessel of 2,600 tons, it was necessary to pump 3,875 tons of water against an average head on the pumps of 16 ft. This was accomplished in 25 minutes, the number of units consumed was 123, while the cost of power supply was reckoned at the rate of 1·375d. per unit.

Against this was placed the case of a graving dock operated by two gas engines, each of 40 H.P., driving horizontal centrifugal pumps, with a capacity of 9,320 gallons per minute, working against an average head of 17 ft. When docking a vessel of 1,760 tons the time taken to empty the dock of 10,632 tons of water was 128 minutes, while the gas consumption was 4,600 cb. ft., and the cost of gas per thousand ft., 1s. 6d.

The two sets of figures were worked out by Mr. Snell on a basis of the actual cost per ton of vessel docked in the two cases, which was in the case of electricity, reckoning power, wages, interest and depreciation, 0·323d., while in the case of gas drive it was 1·045d. The moral of this comparison as instituted by Mr. Snell was that the graving dock represented a much longer run and better load factor, and yet the cost of docking by gas-driven plant was three times that of electrically-driven plant.

In the issue of the *Vulcan* for April, however, Mr. John Kelly joins issue with Mr. Snell on the ground that the figures are worked out to per ton of vessel docked, whereas Mr. Kelly argues that the actual cost for purposes of comparison should be worked out per ton of water pumped, and Mr. Kelly, taking Mr. Snell's figures as a basis, shows that the actual cost per ton of water pumped electrically is 0·218d., while by gas it worked out at 0·173d., or 20 per cent. less than by electricity. Mr. Kelly thereupon includes some rather caustic remarks upon Mr. Snell's deductions, and felicitates him upon his choice of audience.

While not professing to know the complete history of the two tests and their consequent parallelism, or lack of it, it may be worth pointing out that no question is raised as to the ultimate capacity of the graving dock, whereas we know that the electrically-driven pontoon upon test was only loaded up to 2,600 tons, while it was capable of taking 4,000. Mr. Kelly makes a point of the fact that the vessel in the second case was nearly 33 per cent. smaller than in the former case, while the water pumped was 174 per cent. more, against a head of 6 per cent. greater in the second case, and it would be interesting to know how far local conditions necessitated the pumping out of a larger proportion of water per ton of vessel in the second than in the first case. Presumably the officials of the two docks, knowing that results were to be placed in comparison, would hardly care to have an apparently partial statement issued under the protection of their official figures, unless there were some insuperable obstacle to obtaining a perfectly parallel test. We think, however, that the main purpose of Mr. Snell's demonstation is untouched, which is to show that the electrical pumps are able to achieve a good commercial result, *i.e.*, the clearing of water surrounding a vessel in a much more satisfactory manner than by the gas-driven plant, as is shown by the relative times taken by the two sets of apparatus in their work. In the case of electric pumping it was possible to discharge 155 tons per minute, with a plant whose interest and depreciation at 10 per cent. was 0·159d. per ton of vessel docked, while the gas-driven plant was only able to empty 83 tons per minute, with a plant whose first cost can be gauged from the interest and depreciation of 0·587d. per ton of vessel docked. Anyone acquainted with shipbuilding knows the value of time taken in docking such a vessel for quick repair, and on this count alone—rapidity of operation, combined with low capital cost, the electric drive should carry a preponderating value.

There is, however, another aspect of the case which we think is not sufficiently touched upon, this being the values assigned to the cost of electric and gas power, per unit and per 1,000 ft. respectively. Taking the latter first: the gas engines were taking about 4,000 cb. ft. at 1s. 6d. per thousand. It is not often that such a low price per thousand can be given for the purpose of supplying gas engines for dock pumping, which work is intermittent, of large capacity, and liable to be applied without notice. Such a state of things could only exist where coal is cheap and abundant, the gas-supply system large, and where other plant about the works is capable of giving a steady load, rendering it worth while to put in such a low price per thousand. Examining the electric figures, it will be seen that the cost of power supply is 1·375d. per unit. This comes from an outside source, and may presumably be

taken to be a supply from a local central station. A figure of over 1d. from such a source is an extremely unfavourable one to argue with, taking into account the fact that large power-supply companies are now prepared to sell electricity to works at figures represented in fractions of a penny; more particularly is this so in cases such as those suggested by Mr. Snell, where a stipulation was introduced that during peak loads, in the restricted winter months, only one-half of the pumps should be worked. If the figures quoted in the comparison are worth anything at all, therefore, as a broad comparison, it should be necessary to take into account the extraordinary features of the case summarised in maximum price of electric power, minimum price of gas power, neglect of time element on the general work of the graving dock, and insufficient regard to the effect of prime cost for equivalent pumping capacity.

STEAM, GAS AND ELECTRICAL BREAKDOWNS IN 1907.

The annual report of Mr. Michael Longridge, chief engineer of the British Engine, Boiler and Electrical Insurance Co., Ltd., has just been issued, and contains, as usual, a wealth of interesting information. The author remarks regretfully—and he has our sympathy—that for the first time in 26 years he is unable to announce that "no life has yet been lost by the explosion of any certified boiler"; last year a fatal explosion took place due to a fine crack in an angle iron, which escaped notice during the inspection of the boiler. This single instance, though it is naturally most regrettable, will not spoil the splendid record so long held by the company.

Dealing with steam engines, the author reports a rate of breakdown of 1 in 11·7, as against 1 in 8·1 in the previous year. As usual, valves and valve gear figure most largely in the analysis of failures, being responsible for 28 per cent. of the accidents; the average for 24 years was 21 per cent. Spur gearing and air-pump motions came next with 10·2 per cent., as compared with 14·8 and 10·4 respectively for 24 years. No other item exceeds 8 per cent. The author attributes the increase in the number of breakdowns of valve gear to the increase in speeds and number of parts. Spur-gearing is less used nowadays than rope and direct-driving, hence the fewer accidents due to this factor; there is an increase in broken cylinders and pistons, due principally to the use of steam at higher temperatures and pressures than the parts can safely bear.

In the case of gas and oil engines, the rate of breakdown was 1 in 11·1, as against 1 in 12·4, showing an improvement, unlike steam plant. Here, however, valve gear shows a proportion of no less than 43·3 per cent., as compared with 28·7 in the previous year, and 32·5 on the average. Cylinders run to 13·5 per cent., against 16·6, and connecting rods to 8·1, against 11·2 average. Very few piston failures appear, and main shafts have fallen from 15·7 per cent. last year to 4·7 per cent., or a little below the average. Mr. Longridge considers the increased breakages of valve gear very unsatisfactory, and recommends the use of ring lubricators for the side shafts and wrought-iron or good cast-steel for the construction of the levers.

While 38 per cent. of the breakdowns of steam engines are traceable to old defects or deterioration, only 27 per cent. being due to unknown causes, no less than 44 per cent. of the gas engine breakdowns come under the latter category—an unfortunate fact, for unless the cause of the breakdown is known, it is impossible to apply any remedy other than increased strength, proverbially associated with ignorance in the North.

The examples of steam engine breakdowns selected for description by Mr. Longridge are of the usual order; neglect of the Inspectors' recommendations, fatigue of parts of old engines, abrupt changes of section without fillets in piston rods, &c., and distortion of unsymmetrical castings by high temperatures, are followed by the natural consequences. A curious observation was made in the case of an air pump with a barrel 18 in. in diameter; the bucket, a plain casting without packing rings, was ⅜ in. less in diameter than the barrel, yet the indicator diagrams showed a vacuum of 10 lb. in the cylinder with a terminal pressure of 16 lb. absolute, the injection and ejection temperatures being 58° and 88° F. respectively.

The imperative necessity of draining the jackets of gas engines in winter after shutting down is illustrated by a case where four out of five jackets were cracked in one night. Breakages of the bolts holding on the brasses of connecting-rod ends of the marine type are common, the makers apparently failing to realise the magnitude of the stresses due to the inertia and friction of the pistons. The problem of designing a cylinder end "which will not crack under the high temperatures and pressures obtaining in the cylinders of internal-combustion engines has not yet been solved," says Mr. Longridge, "though very marked progress has been made." In one case—a horizontal engine with cylinder 5-in. × 9-in. stroke—the crankshaft broke no fewer than five times, between April, 1904, and August, 1907, the cause being inherent weakness in the design. The author criticises the customary method of casting the fly-wheels of gas engines with solid bosses, and fixing them on the shaft with sunk keys, giving a typical instance in which such a fly-wheel collapsed through loosening of the keys, followed by rocking of the wheel and the splitting of the boss. He prefers to split the boss of the wheel, bore it slightly smaller than the shaft, wedge the two halves apart and slip the wheel on the shaft; then to withdraw the wedge and secure the wheel with two or four strong bolts, no keys being used. The fact that an explosion in the bed-plate of a gas engine may occur when starting, through gas (supplied under pressure) flowing into the cylinder and out through the air inlet into the frame when the engine is being pulled round, is adduced as an explanation of this class of accident. "Explosions of gas-making plants continue to occur," says the author, and he gives full details of a case in which the attendant at a suction-gas plant blew off the top of a scrubber through incorrect manipulation. He points out the risk always attending the testing of the gas when starting up such plant, and suggests that the test cocks should be fitted with wire gauze flame arresters—an elementary precaution that one would have thought obvious and indispensable in such a connection.

The breakdowns of dynamos and motors in 1907 were respectively 1 in 18·7 and 1 in 7·9, as compared with 1 in 16 and 1 in 8·2 during 1906. As before, the D.C. machines broke down more frequently than the A.C., but the cost was much less. Armatures and rotors are the parts most often in trouble, accounting for 35 per cent. (dynamos) and 38 per cent. (motors) of the failures in 1907; but in 1906 the figures were 50 and 44 per cent. respectively. Commutators and brush gear gave rise to 34 and 30 per cent. of the breakdowns, and magnet coils and stators to 7 and 14 per cent., in dynamos and motors respectively. In starting and controlling gear, the resistance coils accounted for 60, as against 48 per cent. last year, contacts and switch arms for 8, compared with 10, and automatic apparatus to 13, as against 17 per cent.; these figures will serve to indicate the directions in which improved design is called for. Dirt and neglect account for a quarter of the dynamo and motor failures, age and deterioration for a similar proportion, and bad work or design for one-fifth.

On one occasion two rats were found wedged between the armature and frame of a motor; on another, a handful of soft soap, stuck on top of the framing of a motor, ran into the stator and caused a burn-out, the water-tight iron box enclosing the motor having been used as a locker for tools, apron, &c., by the workmen. Fires inside motors, started by the ignition of collections of fluff and dust are not uncommon, and oil and dust settling between commutator lugs cause burn-outs. Shunt wires are frequently pulled out of terminals, being inadequately fixed in the latter; the result to be expected in the case of a motor-generator, is racing of the armature to bursting speed. A large number of breakowns are due to faulty or careless commutator design, small spaces being left in which carbon and copper dust are sure to lodge. Cases are recorded in which the armature shaft was $\frac{1}{32}$ in. less in diameter than the bore of the spider.

Dealing with the subject of water-hammer in steam pipes, Mr. Longridge draws special attention to the frequency with which this phenomenon results in the fracture of pipes or valve casings; in 1907 six men lost their lives from this cause. The author analyses in detail 12 cases recorded in the Board of Trade reports, with diagrams showing the conditions under which the accidents occurred.

Hardly two cases are alike, and the extremely varied conditions under which water-hammer is liable to take place render necessary the most minute circumspection in laying out a range of piping, lest pockets or traps for water should occur. The very act of opening a drain cock for the purpose of clearing out water has frequently precipitated precisely the disaster that it was sought to avoid; new piping is especially liable to give trouble, owing to the drains and steam traps being choked with dirt, &c., and the attachment of a drain outlet to the side of a pipe or valve instead of to the lowest possible point is a fruitful source of breakdown. It is strongly emphasised that before draining a length of piping in which the presence of water is known or suspected, the boiler stop valve should be closed. The use of well pipes with tell-tales at the lower ends of ranges is a valuable precaution. In all the cases cited, "the water-hammer was caused by the disturbance of a comparatively large water surface in a horizontal or inclined pipe, in which the water was capable of moving; and wherever there is such a water surface, water-hammer will almost certainly be produced if that surface be disturbed by the opening of a valve or a drain. Therefore, wherever there is any doubt about the presence of water in such a pipe *it is dangerous to attempt to drain the water away without first shutting steam off the pipe.* From a vertical pipe water can be drained with little risk, because the water resting on the bottom end of the pipe cannot be set in motion." The author gives details of a float tell-tale which he suggests, to indicate the height of the water surface in a well pipe.

The report concludes with particulars of trials of two pairs of compound engines. The second of these was provided with a live steam reheater between the cylinders, and was tested both with and without the reheater in action; the effect of the latter appeared to be practically negligible.

Annual Outings.—The annual staff outing of the Armorduct Manufacturing Co., Ltd., took place on Saturday, August 22nd. The London staff, together with the branch managers, agents and friends, joined the launch *Royal Thames* at Molesey Lock, and luncheon was served on board. At Windsor an hour was spent in various ways. On the return journey tea was served, and the party was landed at Tagg's Island Hotel at about 8 o'clock. Dinner was served at the hotel, and after the usual toasts, music and singing occupied the remainder of the evening. A brief speech was made by Mr. Schmahl, the managing director.

THE LEGAL EFFECT OF A TENDER.

[FROM OUR LEGAL CONTRIBUTOR.]

A few weeks ago, in the course of an article commenting on the Mile End case, brief reference was made to the question whether local authorities must or ought to accept the lowest tender. The whole question of tenders is so important, from the point of view of the local authority or other body requiring work to be done, the contractor and the engineer, that a short statement of the law on the subject may be of general interest.

A tender is an offer to do work at a certain cost, based upon specifications which are sent out by employers. As a general rule, the advertisement for tenders contains a statement to the effect that "the corporation (or company, as the case may be) does not undertake to accept the lowest or any tender." If this saving clause is inserted in the advertisement, and a tender is made on the strength of it, the contractor has no cause for complaint. Obviously, there are many considerations besides mere lowness of price which should weigh with the employers in deciding which offer to accept. Financial stability; special knowledge; skill in the construction and erection of particular types of machinery; all these are elements which must be carefully considered. The insertion of the saving proviso gives the engineer, who generally has the duty of deciding the tender, quite a free hand.

But even in the absence of a special clause, the employer's position appears to be fairly safe; for it may be stated that, as a general rule, there is no implied undertaking in an advertisement for tenders to the effect that the lowest tender will be accepted. This rule, however, only holds good where there is no custom of the trade to the contrary. In the case of Pauling *v.* Pontifex (1 W.R. 64), the plaintiff sent to the defendant's agent a tender for the erection of certain buildings. It was held that the Judge was right, having regard to the evidence, in concluding that, according to the custom of the trade, the plaintiff's tender being the lowest, it had been accepted, although their agent had no absolute authority to accept the lowest. In a later case, however, an attempt to establish a custom met with failure. There the defendants had issued a circular in which it was stated that they had been instructed to offer to the wholesale trade for sale by tender the stock-in-trade of a certain firm, which they announced would be sold at a discount in one lot. They also stated in the circular the day and hour when the tenders would be received and opened at their offices. The plaintiffs made a tender which they alleged was the highest. In an action against the defendants for not accepting such tender it was decided by the Court that the circular was only an invitation for offers, and that there was no implied undertaking by the defendants to accept any tender at all.

We are fairly confident that no "custom" to accept the lowest tender could be set up in the electrical world, although it may be, and often does, turn out that the lowest tenderer is successful. Yet a tender must be *bonâ fide*, and not in any way likely to open the door to fraud. For instance, suppose employers agreed to accept the lowest tender for the erection of a certain plant, and that a contractor sent in a tender by which he undertook to do the work for, say, a less sum by £100 than any sum mentioned by any of his rivals. It has been held that this kind of tender is invalid and will not be supported by the Court.

The case of the South Hetton Coal Co. *v.* Haswell (1898) 14 T.L.R. 277 is of interest in this connection. In that instance an offer was made by certain vendors to accept the highest net money tender they should receive (all other things being equal) from one of two rival purchasers. One party offered a certain sum; the other offered such a sum as would exceed by £200 the amount offered by the other proposing purchaser. Upon a refusal on the part of the vendors to accept this offer, an action was brought for specific performance. The Court refused to grant a decree. Lord Lindley, then Master of the Rolls, when the case came before him in the Court of Appeal, said:—"The plaintiffs' offer is illusory; it does not answer to the description of the highest money tender either in the business sense or in the legal sense of the words. To hold that the plaintiffs' offer answered that description would be to encourage trickery and chicanery. It would be opening the door to the grossest fraud, not only towards purchasers, but towards vendors also."

A most important question arises as to the validity of an agreement amongst a number of contractors not to tender for a particular piece of work. This course is sometimes adopted in order to leave the field clear for an independent contractor who may be under agreement to share profits with those who have stood out of the way. The principle that such an agreement is not void was declared in the case of Jones *v.* North (19 L.R. Eq. 426). There it appeared that tenders for the supply of stone were invited by a corporation. Four neighbouring quarry owners entered into an agreement that they should each supply a certain proportion of the stone, and that the plaintiffs should make the lowest tender to the corporation. The plaintiffs entered into contracts with the other quarry owners to purchase the proportion of stone agreed from each. Notwithstanding the agreement, one of the quarry owners sent in a tender which was accepted by the corporation. The other quarry owners, who had been parties to the agreement, thereupon applied to the Court of Chancery for an injunction to restrain the supply of stone to the corporation by the defendants. It was held, over-ruling an objection by the defendants, that the agreement was not void either as against public policy, or upon any other ground.

It is worth while to record that an agreement of this kind extends beyond the contract which is within the immediate contemplation of the parties. Thus two dealers, A and B, agreed not to tender in competition with each other for gas tar, in pursuance of which compact A sent in a nominal tender. B secured the contract. Subsequently, when fresh advertisements were issued, B again tendered without having communicated with A. It was decided that he was liable to pay damages for breach of contract (Metcalf *v.* Bonck, 25 L.T. 539).

This notice cannot be concluded without a word of warning to those who are about to enter into a contract with a local authority or company. Mere tender and acceptance will not, in such a case, be a sufficient contract. In Jackson *v.* North Wales Railway (1 H. & Tw. 75) a contractor sent in a tender to a railway company for the execution of part of the works, either with a double or single line of rails. He was informed that his tender was accepted; and that intimation was confirmed by the directors, upon his attendance at one of their board meetings, but no document accepting the tender was executed by the company in such a manner as to be binding at law; nor was any conclusion ever come to whether there should be a single or a double line. The railway was afterwards abandoned, and the contractor then brought an action to have it declared that the contract was binding on the company, or to have it declared that they were liable in damages. It was held that a mere allegation that the company had money in their hands for the purpose of paying the plaintiff was not sufficient to enable him to succeed in his action.

MODERN STEAM BOILER PRACTICE.

By W. H. BOOTH.

It may be laid down as a rule, with few exceptions, that almost any boiler with ordinary ratios of heating and grate surfaces can be worked so as to show an efficiency as ordinarily stated of 70 per cent.; that is to say, that of the total calorific power of the fuel burned in the furnace, seven-tenths will be found in the steam sent out. It is equally true that not one of all the boilers will show an efficiency passing 80 per cent. Tests have, it is true, been published which show more, but it is hardly likely that the excess above 80 per cent. was due to anything more than the fortuitous co-operation all in one direction of the many errors that may creep into any test. In face of this, it is a little difficult to understand the attitude of that section of the inventive public which continues to put forward new designs of boiler which show results better by 20 per cent. than

those of existing boilers. Such economies can only be shown in comparison with tests made upon boilers in bad condition. If a new steam boiler is put forward on the merit of its economy, it may at once be shelved if on test it cannot show over 70 per cent. efficiency; but it is not necessary that a boiler should show 80 per cent. in order to justify its use, for it may fulfil certain requirements that render it specially valuable for certain duties.

Boilers which are to work continuously for long hours are properly of a very different order from those required to work briskly for a few minutes. The brickwork seatings of large boilers will absorb large amounts of heat. As far as possible, when such boilers are brought to rest, the endeavour should be made to reduce their water-level to a minimum during the later period of activity in order to enable the fires to be reduced to a minimum and the fullest use to be made of the heat stored in the bricks. Then, when laid off, the dampers should be capable of being tightly closed, and during the period of rest the water-level should be brought gradually up, so as to absorb the heat from the brickwork without producing steam to be wasted. So long as any work at all is going on, there need rarely be any serious amount of steam blown to waste. The heat wasted from brick walls is considerable. A single boiler has two exposed side walls. Water-tube boilers of any number are usually set in pairs and have but one exposed side wall per boiler.

Batteries of shell boilers possess the advantage that they may be set side by side without side passages, and for any number of boilers there need be but two exposed side walls. In working such a battery, the best economy is to be got by working as many as possible side by side, that is to say, if there are ten boilers, and five of them are at rest, the working boilers should be Nos. 1 to 5, or 6 to 10, or 3 to 7, and so on, as far as can be arranged, and not 1, 3, 5, 7, 9 or 2, 4, 6, 8, 10, whereby there would be so many more walls radiating heat to external air.

It is not many years ago since the writer was criticised as too finicking, when he laid it down as essential to economy that boiler brickwork ought to be painted or otherwise rendered air-proof in order to stop the infiltration of external air to cool the flues. This practice is now becoming very usual, and is often put forward as a fresh discovery. Hot air is obviously correct for feeding furnaces, because it must ultimately pass away hot, and any initial heat must mean economy. But it has not always been found successful, probably because the hot air is so much more bulky that sufficient does not find its way to the fires. With induced or forced draught this defect may be overcome, and there is a possible future economy in steam generation to be obtained by coupling up the flues of laid off boilers to the air ducts leading to the working boilers, in order to use the stored heat in the brickwork. Any engineer who has tested a boiler with a Dutch-oven type of furnace, will know what a large amount of heat may be taken up by the brickwork when the furnace is heavily built, and will realise what is to be got back by a regenerative system. When the production of smoke is forbidden, as it will be when the public really appreciate the fact of its easy prevention and magistrates become better educated to the daily facts of life, furnaces of the Dutch-oven type and its modifications will be more common, and means will undoubtedly be sought for preventing the loss of their stored heat when laid off. In Germany there are furnaces on wheels, of this kind, which are made easily movable back from the boiler for inspection, repair and cleaning. The future may see such furnaces arranged for lateral transference from one boiler to another, so that heat may not be wasted when a boiler is laid off for cleaning, for its furnace will be moved to another boiler.

In many trades, but in none, perhaps, so much as in electricity supply, there is a period of short continuance of a maximum load very much in excess of the average load. Considerations of economy demand that, if practicable, this load shall not demand an equally abnormal amount of plant. As regards engine power, the peak is toned down in its effect by the use of a battery or accumulator, and the engines at such time also are run beyond their loading of best economy. The accumulator helps the boilers, of course, but the less economical running of the engines makes a demand on the boilers for steam which is even more than is usually demanded for the same power. The peak load comes on very suddenly, and has to be prepared for by getting more boilers up to pressure. The peak falls off rapidly and leaves the boilers with a lot of stored heat to be wasted during the long hours of rest. For this peak load, or for a large part of it, a flash boiler would be an ideal steam generator. A near approach to a flash boiler, such, for example, as the Solignac boiler, presents itself as a suitable steam generator for such conditions. But a semi-flash boiler requires a fuel of the same order. Liquid fuel offers itself as the fuel, therefore, of the peak load. These semi-flash boilers may be put into full steam from cold water in five minutes with a coal fire started with wood. With liquid fuel and a shovelful of hot coals from another furnace such a boiler could be made to give full steam in less than the time stated, for it is not necessary to have more water in the boiler than will cover the bottom of the steam drum when starting up, and the feed can then be set very gradually to gain on the steam output.

A few of these small boilers will give an enormous output of steam. As the load drops off they can one by one be stopped. They are not heavily bricked, and could be cooled by the method suggested if necessary. With such boilers much of the anxiety and worry of a power station would be abolished, for these almost waterless boilers have no inertia, they will give quickly their maximum yield of steam, and have an enormous evaporation per square foot of floor space occupied. If their efficiency is not very great at their maximum output, the hot gases are economised in the feed heater, and this is assisted during the period when it is most heavily loaded. There is an elasticity about such a system of steam generation. There is no fuel so convenient to use as liquid fuel, but for large powers and long hours it is often too expensive. But for the top half of the sharp peak of a lighting load, such boilers with liquid fuel, and a suitable system of working, offer themselves as an economical plant. Naturally, with the peak occurring every day, there would not be the same hurry as when a fog comes suddenly along, for the main boilers would have been gradually filled a little full with water, and would be drawn on to supply fully hot water to the little boilers, as each one was lighted up.

Thus in a well-considered scheme of steam generation for any intermittent work, there would be two types of boiler of extreme difference, and two varieties of fuel, and there would be appliances for using up heat that would otherwise be wasted.

Another essential in modern practice will be that boilers and furnaces, though so closely conjoined, will come to be regarded as two separate entities. The furnace will be regarded as a factory of heat units at a high temperature, and the boiler as an absorber of heat from hot gases, or from radiant solids.

It is, of course, essential that economy should not be purchased at too high a cost. What may be termed economy plant, must pay interest and depreciation and any extra labour charges on its outlay and working expenses. But it may have been noticed of late years that a brand of engineers has risen up who have made a fetish of what it pleases them to call commercial economy. This fetish they will worship down to 15 in. of vacuum, with cold water at 60° F., stating boldly that in the peculiar circumstances of their particular case it would not spell true economy to strive for anything better. The only commercial economy they really practise is for their own ease and comfort. It is the same in boiler work. One may buy fuel economy too dearly, but this fact is not a sufficient warrant for grudging a pail of tar to paint porous walls for air-tightness.

What has been so much lacking in boiler practice is the sense of proportion and of fact.

Because a given boiler has a very small water capacity, it is easy to get steam up quickly from cold water. Because of this many engineers state and really believe that a boiler with small water capacity will answer more quickly to a sudden demand for more steam, whereas obviously the reverse is the case.

The boiler with the greatest water capacity will answer best to a sudden call for more steam at the same or at less pressure. The boiler of small water capacity will best meet a demand for steam at a higher pressure. This is an essen-

tial difference, inability to grasp which seems to be rooted in many minds.

Within reason an easily worked boiler will give better economy than a forced boiler, but there is an early limit to the economy, for every boiler added to the plant introduces so much more capital cost, and also adds to the heat losses by radiation, and so it would soon come about that extra boilers as a free gift would not produce economy; for the radiation loss would overbalance the economy, and the economy apart from radiation loss becomes less with each additional boiler. Boilers with large water capacity are comfortable to work with, because they respond so promptly to a call for steam. If the fire would respond as promptly to increased draught there would be no need for water capacity; but a massive fire of coal does not at once respond to the urgency of a better draught, though much may be done by the aid of mechanically urged draught.

Liquid fuel responds instantly, and the increase of heat units generated in the furnace may be practically as prompt as the response of a mass of heated water when relieved of a little of the pressure upon it. Hence the value of a semi-flash boiler with liquid fuel for getting over the sudden demand of the peak load. It is often urged that cheap engines might be used to meet the peak load. But a reliable cheap engine is not much cheaper than a first-class engine, and it should not be overlooked that if the engines are uneconomical there must be a correspondingly greater outlay on boilers to produce the steam wasted. Extra boilers will very soon out-cost the small saving in cheap engines, and the craze for cheapness may very soon cost heavily in fuel.

Perhaps bad results with furnaces are most frequently the result of bad ratios of grate surface to fuel burned per hour and to draught intensity. Fuel ought to be graded as to size, for if it is not of equal size and mixture throughout the mass of the fire there is uneven combustion, the fire burns thin in places, and the chimney capacity is satisfied by cold air which flows unconsumed through the thin and bare places, and diminishes the tendency for air to flow in through the thicker parts of the fire. Ordinarily the excess of air is very large, and each pound of the excess carries with it so much wasted heat. Hence the proposal that some of the chimney gas, with its load of heat and its free oxygen, should be returned to the furnace. Very small fuel can usually be purchased for a price per million heat units capacity much less than large fuel. But the small fuel cannot so well be burned at a high rate per unit of grate area. Here is one of the great advantages of the water-tube or other externally fired boiler. The grate area can be made of much larger area than is possible with a shell boiler, and the fuel burned not only at a suitable rate per unit of grate area, but also per unit of heating surface of the boiler. With a shell boiler, internally fired, to use small coal may mean an extra boiler. With an externally fired boiler, it should be possible to add to the grate area.

No new boiler power should be laid down which does not provide for a considerable space more than usual between the boiler and the floor. The smoke nuisance at most electrical stations is likely to be permanent so long as this initial error stands in the way of the rational remedy for smoke. Most boilers and their housings and pipe designs preclude much improvement. This fault has arisen from the long-standing habit of regarding boilers and furnaces as one instead of two distinct apparatus.

As a consequence, boiler houses are utterly devoid of elasticity or the capacity for being improved.

Japan's Electric Wire Trade.—The modern development of the electrical business in Japan has resulted in such a large demand for electric wire that (according to the New York *Electrical Review*) the annual sale of the article amounts to about 8,000,000 yen. "Of this, 5,000,000 yen's worth is imported from abroad. It is admitted that the imported wire excels the home-made in quality, and it is generally used in warships, steamers, and also for underground work. The art of electric-wire manufacture has, however, made rapid strides in Japan of late years, and this, coupled with the ample supply of cheap copper, has reduced the cost of production, with the result that the wire is offered at a price considerably lower than is charged for the imported article."

LIQUID FUEL.

The full report of the trials of liquid fuel by the United States Liquid Fuel Board, issued some time, ago contains some interesting particulars. The decision is arrived at that liquid fuel can only be burned satisfactorily if atomised. Systems of gasification are not advised, and they express their opinion of to-day by reprinting Isherwood's report of over thirty years ago in favour of atomisation only. They also give an interesting classification of the various types of atomiser. All atomisers can practically be put into one or other of five classes. Mechanical atomisers which work without either steam or air seems to be quite satisfactory, and tests on an Italian steamer, the ss. *Tebe*, showed that a very little more than 1 lb. of fuel per I.H.P.-hour was used on various voyages. In order that such jets shall properly atomise, the oil must be heated sufficiently to become limpid and capable of breaking up. The air supply must also be heated, and the oil must come to the burner orifice at no less than 40 lb. pressure, while cases are reported satisfactory at 150 lb. oil pressure.

Considering how satisfactory the mixed system of coal and oil is reported to be by Mr. Holden, of the Great Eastern Railway, it is curious to note in this report of the Liquid Fuel Board that they strongly advise against any attempt to combine both systems. Yet M. Bertin, of the French Navy, reported quite favourably on the combination. He seemed to find that whereas both coal and oil required an excess of air for proper combustion, yet the burning of liquid fuel over a solid fuel fire practically made use of the same excess of air as had served the coal, and that the air thus far served its purpose twice over, such purpose, of course, being merely that of dilution, which raises the point whether, if air excess is nothing else but dilution, the excess of gas volume in a furnace might not be secured by the employment of some of the hot chimney gases. If a portion of chimney gas could thus be sent round a second time to the furnace, its oxygen contents would be applicable to combustion, and the gas would thus make two circuits of the flues and yet go to final waste with one burden of heat only.

The absence of a grate in most liquid fuel furnaces greatly reduces the resistance to the flow of gases. In the *Nebraskan* with Scotch boilers, the smoke stack temperature was 1,800° F., and the gas velocity was reduced by the employment of spiral retarders having one convolution per foot of length of a 3-in. tube. In this ship again about 1·10 lb. of oil was used per I.H.P.-hour. The stack temperature was about 500° F., as a mean of several tests. The boiler, on which the trials of the Board were made, consisted of a pair of headers, between which flatly inclined tubes sloped each way. There was a deep firebrick box furnace roofed by a single row of tubes closed over most of their length by fire tiles, and before the gases could escape among the general bank of tubes, other baffles of fire tiles were placed to divert the flames towards the same end as the "fire door," or rather the atomiser which took its place. The same boiler was used for the tests of a large number of atomisers, and it was found that almost all who had an atomiser to test had very little knowledge of what their apparatus would do. In many cases apparatus proved quite a failure, and the experienced officers who conducted the tests were able to get better results out of inventors' apparatus than could be got by the inventors themselves. This is perhaps nothing extraordinary, for it often happens in other matters, and most people who have had to deal with the inventor who has not had a good training, know that he is least disposed of when chained up and left free to bark only and not to bite.

Since the report of the Fuel Board of the U.S. Navy was issued a good deal of work has been accomplished in the British Navy, and so far as results have become known, we believe that we are correct in saying that any difficulties with the mixed system have been overcome or not encountered. Much, of course, depends on the allowance of sufficient combustion space and the proper supply of air both for the liquid fuel above the fire and the solid fuel on the grate. On this subject M. Bertin, of the French Navy, appears to have arrived at sound conclusions.

AN AMERICAN VIEW OF DEPRECIATION.

The American *Electrical Railway Review* some time ago published an interesting paper upon depreciation in connection with electricity undertakings. It was an abstract of an address by C. N. Duffy, Comptroller, Milwaukee Electric Railway and Light Co., delivered before the convention of the North-Western Electrical Association, Milwaukee.

It is pointed out that the public utility law of Wisconsin provides that:—"Every public utility shall carry a proper and adequate depreciation account whenever the Commission, after investigation, shall determine that such depreciation account can be reasonably required," and it goes on to provide for arriving at the rates of depreciation that from time to time may be found necessary.

To begin at the beginning, Mr. Duffy appeals to the dictionaries for the meaning of the word "Depreciation," a useful preliminary instruction which we commend to apologists of the system among municipal traders in our own country of seeking, in the sinking

fund for repayment of borrowed money, the provision for depreciation.

Mr. Duffy adopts Webster as his authority for defining it as the "lessening of value," and he amplifies this by the various causes of depreciated value:—(1) Deterioration due to the ravages of time; (2) Wear and tear incident to use; (3) Displacement by reason of obsolescence or supersession resulting from the development of the art or the evolution of the business.

All this is, of course, very elementary and beyond controversy, and was summarised in the evidence he refers to of Mr. Gibbs, an eminent engineer, in the case of The People of the State of New York *ex rel.* the Third Avenue Railroad Co. against the State Board of Tax Commissioners, who said: "I never yet did a piece of work that extended over any considerable time but that, when I got it done, it was rather antiquated, and had to be done over again; it is a new science."

The practical question resolves itself into a matter of accountancy—and here Mr. Duffy admits "the difficulty of laying down a fixed rule that will determine the measure of depreciation to be provided for and to cover in a practical and satisfactory manner differences in conditions and the various factors to be considered."

We know that in some cases local authorities, anxious to present accurate accounts, have dealt with depreciation by a scale of percentages on original cost, varying with the character of the expenditure, whether land, buildings, engines, boilers, accumulators, instruments, &c., and writing off an equated amount annually; but, on the other hand, the future has often been left to take care of itself, and the municipal trader has satisfied his conscience by making the payment by instalments of original cost answerable for the "lessening of value."

The most difficult condition to deal with is, no doubt, the depreciation by obsolescence or supersession—and here we find Mr. Duffy introducing "amortisation" in addition to providing for the ordinary items of depreciation.

To adopt Mr. Duffy's principle of getting at the dictionary meaning of the word, amortisation may be defined as "to redeem by a sinking fund," and if through necessity physical property is disposed of as junk or scrap, the loss must be provided for in this way.

A suggestion of Mr. Duffy's is to consider all these items of depreciation and contingencies in the cost of the electrical energy. From the consumer's point of view, the matter considered is the cost in comparison with the system proposed to be superseded, and the supplier secures his customer if he can satisfy him of the advantage of making the change. There are many conditions to be dealt with in fixing the price to be charged, such as the nature of the demand in relation to load factor, character of the district, &c.

As Mr. Duffy points out, the subtraction of ordinary or current operating expenses and taxes from gross earnings does not represent net earnings available for interest on bonds, or dividends on stock.

BUSINESS NOTES.

Installation Contract.—The Electromotor and Dynamo Co. obtained the order for the electrical plant required for the new works of Messrs. "X" Chair Patents Co., Ltd. The plant consists of one 75-kw. dynamo, and eight motors aggregating 112 h.p., together with switchboard and complete installation.

Kidderminster District and New Factory Facilities.—Manufacturers in recent years have shown a tendency to migrate from crowded industrial centres where rates and wages are high to more congenial and economical districts, where they can have the advantage of cheap land, low rates and taxes, cheap power and water supply, plentiful supply of labour, convenient transport facilities and ample housing accommodation. All these advantages are stated to be obtainable in the Kidderminster district, and with a view to assisting manufacturers who are considering the matter the Kidderminster and District Electric Lighting and Traction Co., Ltd., have issued a booklet giving the necessary information. Readers can obtain copies of this booklet from the managing engineer of the company, who will be pleased to answer any inquiries as to available factories and factory sites, labour, power supply, &c. The local offices are situated in Market Street, Kidderminster. This company is already supplying energy to a large number of carpet factories, and the motors connected to the mains at the present time are equivalent to over 1,000 h.p.

The Aluminium Convention and Competing Firms.—The *Financial News* Zurich correspondent says that it is proposed shortly to cancel the convention concluded between the principal aluminium manufacturers, and to call a fresh conference with the object of deciding upon measures to be taken against competing firms which have been founded since the convention was arranged.

Limited Company Fined.—Last week at the Mansion House the Fenchurch Engineering Co., Ltd., New London Street, Crutched Friars, was fined £1 per day for 150 days, for having made default in forwarding to the Registrar of Joint Stock Companies the annual list and summary for the year 1907, as required by the provisions of Sec. 26 of the Companies' Act, 1862, and Sec. 19 of the Companies' Act, 1900.

Brockie-Pell Lamps.—We understand that the Brockie-Pell Arc Lamp Co., who have recently removed their works to Wimbledon, have just executed a large order for workshop lighting in Lancashire, and are now engaged on an order for 300 of their standard open-type double-carbon arc lamps for one of the leading railway companies. We learn that they are also doing considerable business in their new high-efficiency auto-transformers for metallic-filament lamps.

A Rival to Celluloid.—According to an American Consular report from Chemnitz, a German chemist has lately perfected a process which brings into competition with celluloid a new composition possessing similar plastic and elastic properties, but free from the easy and somewhat dangerous combustibility common to celluloid articles. To what extent the new composition can replace celluloid is not yet definitely ascertained.—*Birmingham Daily Post.*

Catalogues and Lists.—International Electric Co., 55, Redcross Street, London, E.C.—Illustrated pamphlet entitled "Field Telephony," in which "A Field Officer" gives a descriptive account of the "Medhurst" field telephone and telegraph instrument and accessories in the light of practical experience. A leaflet issued by the same company gives illustrations and prices of the "Orieco" metallic-filament lamps.

Mr. C. Schniewindt, Neuenrade, Westphalia, Germany.—Leaflet in English, describing and giving prices of electric heating nets, which are composed of fine resistance wires woven together with pure asbestos strings.

Messrs. Matthew Wells & Co., Hardman Street, Manchester.—Small booklet dealing with the subject of the lubrication of steam engines, in which they draw the attention of engineers to the advantages of their "Wellsaline" lubricants. Copies of the list may be obtained on application.

Messrs. Babcock & Wilcox, Ltd., 30, Farringdon Street, London, E.C.—New four-page list containing an illustrated description of their automatic exhaust relief valves, which have been specially designed for working with high-speed engines, steam turbines, &c., and many of which they have supplied during the last year or two in connection with large steam plants. The firm have patterns of various sizes up to 30 in.

The Brockie-Pell Arc Lamp Co., Wimbledon, S.W.—New price list of their open, enclosed, miniature, and flame arc lamps, the flame and miniature designs being new ones which they are now placing on the market. The miniature is an ornamental lamp of solid construction, and it is made for all circuits, direct and alternating current. The "Brockie-Pell" flame lamp is made on the principle of the firm's open-type lamp, adapted for use with flame carbons, and is designed to burn from 10 to 32 hours (or still longer, to special requirements) for yellow or white light.

The Linolite Co., 25, Victoria Street, S.W.—A number of new lists relating to their "Tubolite," pointing out certain new patterns that have been put on the market, and announcing reductions in prices. A metallic-filament "Tubolite" lamp will shortly be placed on the market.

Messrs. Mavor & Coulson, Ltd., 47, Broad Street, Mile End, Glasgow.—88-page catalogue of illustrations of electric power plants that have been installed by the firm. Art paper is used throughout, each page having an excellent half-tone view of their engines or machines. The pictures show a number of engine and dynamo sets, direct-coupled ship-lighting plants, gas and petrol-driven dynamos, various dynamos and motors, electric motor applications to mining operations (underground and surface plant), electrically driven examples in engineering and steel works, shipyards, textile and other factories, motor-driven dredgers and cranes.

Messrs. Escher, Wyss & Co. (Jens Orten-Böving), 72, Victoria Street, S.W.—Print and tabulated data relating to the Zodel-Voith patent flexible insulating couplings, which have been largely used for connecting steam and other prime movers to generators. These couplings can be seen working on Messrs. Mather & Platt's stand at the Franco-British Exhibition.

The Armorduct Manufacturing Co., Ltd., Farringdon Avenue, E.C.—Pamphlet describing the "Little Hustler" electrical drills and grinders, for d.c. and a.c. These are made as breast drills, or with screw feed, pedestal and bracket drills, portable bogie drills, &c., and are provided with magnetic hold-on equipment if required. Portable and fixed grinders and buffing machines are also made, and a special type of flexible shaft. A drill for soft stone, slate, &c., has been included in the new list, capable of drilling a hole 1¼ in. in diameter 15 in. per minute.

The Santoni Arc Lamp & Engineering Co., Ltd., 11, Farringdon Avenue, London, E.C.—Pamphlet No. K 9, in which they give some particulars with prices of their intense flame lamps, "Santoni Luxrae" pattern 1908 (for 10, 20 and 40 hours' burning), which are their latest patterns and are of British manufacture. The "Perl" enclosed lamps for 100 hours' burning are also described; they are the latest product at the firm's factory at Charlton. The list before us also refers to the facilities that the firm have for executing re-winding and repairs to electrical and steam machinery, &c.

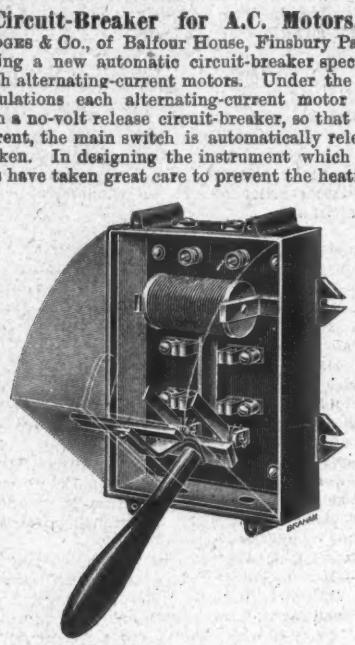
Messrs. Heap & Johnson, 28, Hatton Garden, E.C.—Leaflet relating to the glass brush for commutators, which has already been noticed in our pages.

The Union Electric Co., Ltd., Park Street, Southwark, S.E.—Folder about the Excello lamp, with a 'bus ticket to "Business Prosperity," and a shameless pun which we will not reproduce; central stations can have these folders with their own names printed on, gratis.

The Sunbeam Lamp Co., Ltd., Park Road, Gateshead.—Pamphlet giving particulars of the "Sunbeam Metal" lamp (patent),

which is now being placed on the market. This tungsten lamp is suitable for D.C. and A.C. circuits, burns in any position, takes 1¼ watts per British candle-power, and is made in various sizes, including 50 and 100 C.P. for 200—250-volt circuit. Delivery is guaranteed in lots of 50 and upwards. Sunbeam carbon and heating lamps, adapters, &c., are also listed.

New Circuit-Breaker for A.C. Motors.—Messrs. Cecil Hodges & Co., of Balfour House, Finsbury Pavement, E.C., are supplying a new automatic circuit-breaker specially designed for use with alternating-current motors. Under the new Board of Trade regulations each alternating-current motor must be protected with a no-volt release circuit-breaker, so that on the failure of the current, the main switch is automatically released and the circuit broken. In designing the instrument which we illustrate, the makers have taken great care to prevent the heating and noise



A.C. No-Volt Release Circuit Breaker.

which usually take place in this class of apparatus on alternating-current circuits, and a large number of experiments was carried out to ensure their proper working before they were put on the market. Messrs. Hodges have been making circuit-breakers for the last 15 years, and consequently have a large experience in this class of work. Lowness of price is claimed as one of the chief merits of the device, as that is of considerable consequence in installations where there are a number of machines.

Turkey.—According to the *Board of Trade Journal* H.M. Consulate-General at Smyrna reports that electrical appliances, hitherto very strictly excluded from Turkey, are now being gradually introduced. Motor-cars and motor-launches *using benzine* are only permitted on condition that they are to be used outside the towns. There is an idea of employing motor-cars for inland postal service where railways do not exist.

Consular Notes.—Brazil.—The British Consul at Rio de Janeiro reports that the Rio de Janeiro Tramway, Light and Power Co., which is registered in Toronto, has been operating in Rio de Janeiro since 1905, and has practically (March, 1908) completed its hydro-electric installation on the River das Lages, in the State of Rio de Janeiro, about 51 miles from the city. The works, which are said to comprise one of the most complete hydro-electric installations yet constructed, include a concrete dam 110 ft. high and 700 ft. long on the top, creating a reservoir with a capacity of 221,000,000 cb. metres of water. From this reservoir the water is conducted to the power station through steel pipes a distance of about 7,420 ft., the fall in this instance being about 1,080 ft. The power station, which is located on the river, is of steel construction, with concrete walls for the lower portion, and brick for the upper, the dimensions being 232 ft. long × 102 ft. wide between the main columns. There are six wheels of 9,000 H.P. capacity each for the generators, and two wheels of 400 H.P. each for the exciters, all of the impulse type. The transformers are of the oil and water cooled type. The transmission line, which is 51 miles in length, is located upon the private right of way of the company in its whole extension, the width varying from 132 ft. in Rio, to 300 ft. in the country districts of the State. The power is received over four circuits suspended on two lines of steel towers, 1,052 in number in the whole distance between the power station at Rio das Lages and the terminal station, which is situated at Rua Frei Caneca in Rio de Janeiro. This terminal station is of steel construction, with concrete walls for the lower portion, and brick for the upper, the dimensions being 243 ft. long × 133 ft. wide. The distribution network of the three-phase 6,000-volt system leaving the stations is in the suburbs suspended on iron poles, and in the central part of the city, with branches to all the populous districts, consists of underground lead-covered cables. For the purpose of the underground work there has been built a network of conduits, of which up to the present there have been laid over 1,400,000 lineal ft., connected with 74 subterranean transformer vaults. For the service of the works the company has constructed a railway 16½ miles in length, connecting the Central or Government Railway with its power station at Rio das Lages. To provide power for construction purposes and for use in Rio de Janeiro pending the completion of the large power station, a temporary plant of 3,400 H.P. was installed. The energy produced at this installation was used for the illumination of Rio de Janeiro and the vicinity, as also for the operation of the street car systems, factories, &c., pending the completion of the permanent power house. As all coal is imported, the cost of steam power in the city is very high. The company estimate the steam power now in use to be at least 20,000 H.P., which they expect to be replaced by electrical power within a few years. This is exclusive of the amount which will be required for electric lighting and tramways. In addition to the Rio das Lages power station, which will have a maximum capacity of 50,000 H.P., the company has obtained a concession from the State of Rio de Janeiro to divert the waters of the River Pirahy, which flows in a valley adjacent to that of the Rio das Lages. The amount of the water flowing in the Pirahy is much greater than that in the Lages, and by means of the addition of the flood waters of that river to the power of the Rio das Lages, the capacity can, by an extension of the power station, be increased to 100,000 H.P., or even more if required. The diversion can, it is asserted, be made at comparatively small expense by the construction of a small dam and a tunnel about two miles in length. The company, either by concessions made to it directly or by subsidiary companies controlled by it, exploits the following public services:—The company is the owner of the share capital of the Companhias Sao Christovao, Carris Urbanos and Villa Isabel, which provide about three-quarters of the tramway service of Rio de Janeiro, under concessions from the municipality of the Federal District. By a contract made in the month of November, 1907, with the municipality, these concessions were consolidated and extended until the year 1970, the Rio de Janeiro Tramway, Light and Power Co. undertaking to electrify them within about three years, and to construct about 20 miles of new lines. The lines of the Villa Isabel are already electrified, and the work of transforming the tramways of the other companies is commenced. The Société Anonyme de Gaz de Rio de Janeiro, a Belgian company, acquired by the Rio de Janeiro Tramway, Light and Power Co., controls the whole of the illumination of the city by gas and electricity in virtue of a concession from the Federal Government to 1945, with monopoly to 1915. All parts of the city are now illuminated by gas, the electric lighting being confined for the present to the new avenues recently opened and the central commercial section. It is expected that during the present year the electric lighting will be greatly extended. The company, by virtue of a concession from the municipality of Rio de Janeiro, enjoys a monopoly for the distribution of electric power, produced in an hydraulic installation, until the year 1915 and thereafter the right continues without monopoly until 1990. At the present time only about 3,000 H.P. is available for use, but now that the permanent installations of the company are practically completed they expect, within a few months, to greatly increase this, as many factories now using steam power seem ready to change it for electric. The telephone concession, formerly exploited by a German company, was recently acquired by the Rio de Janeiro Tramway, Light and Power Co., and gives exclusive rights for telephones in the Federal District. This system has been recently largely reconstructed, the building where the installation is situated, which was destroyed by fire, having been rebuilt and installed with a new central battery telephone board of the most modern design. There are now about 2,500 subscribers, and the company expects within another year to increase this to the full capacity of the present board, which is 5,000. In addition to the reconstruction of the building and installation of the new switchboard, all of the subscribers' instruments have been replaced by improved instruments. The street circuits have been overhauled, and a large amount of aerial cable has been installed to take the place of the network of overhead wires in the streets, thus greatly improving the service. A large part of the system is in underground cables, and it is expected that this will be extended from year to year until all the overhead wires in the populous districts have been removed.

Temperley Transporters.—We are informed that the Glasgow Corporation has recently placed with Messrs. Applebys, Ltd., the order for a "Temperley" patent travelling tower transporter, fitted with high-speed grab machinery, for installation at the Port Dundas electricity station. The total transporting distance will be 98 ft., and the lifting speed 240 ft. per minute. In addition to the foregoing, Messrs. Applebys have been entrusted by the Buenos Ayres Great Southern Railway Co. with the work of providing two "Temperley" patent electric travelling and slewing bridge transporters at their Buenos Ayres freight terminal. Each of these transporters will be fitted with grabs, automatic dumping skips and with weighing machines.

"Simplex" Signs.—Messrs. Simplex Conduits, Ltd., announce that they have opened a new department at their Birmingham factory for the construction of various electric signs, of which they give some illustrations and particulars in a recently issued leaflet. In these signs they claim that, by the practical utilisation of the reflective value of the specially prepared tin used, one lamp is able to do the same work that eight or nine are required for in wood letter signs. The colouring and other effects may be seen by any member of the trade at 11, Denmark Street, Charing Cross Road, W.C.

Trade Announcements.—The Ecco Battery and Electrical Co. announce that owing to increased business and to the necessity for being within easy reach of the City, they have had a factory built and equipped at Invicta Works, Bow Common Lane, Bow.

The Lancaster Electrical Supply Co. has removed from Market Street to larger premises in Great John Street, Lancaster.

Messrs. Conrad Lauer & Co. have started business as boiler and steam pipe coverers at 65, Euston Road, London, N.W. Mr. Conrad Lauer has been associated for the last 25 years with Messrs. A. Haacke & Co., of Homerton, which business has been converted into a limited company, but Mr. Lauer has now no connection whatever with the new concern.

Mr. George Cross has left the employment of Messrs. A. Haacke and Co. Ltd., Homerton, and is now representing Messrs. Conrad Lauer & Co.

Canada.—A new electrical firm has been incorporated in Toronto under the name of the Interurban Electric Co., Ltd, with a capital of $400,000. The object of the company is to carry on business in the city of Toronto for the production of steam and water power, and for the production, sale and distribution of electricity, and to acquire the plant of the Stark T. L. and P. System, Ltd., and to acquire the stock of any company having similar objects. The head office is in Toronto.

Bankruptcy Proceedings.—*Re* W. T. Garnett, electric cable and wire manufacturer, Barkerend Mills, Bradford.—A meeting of the creditors was held at the offices of the Official Receiver for Bradford on Wednesday, August 26th, there being a large attendance. Mr. Edgar Musgrave was appointed trustee upon the motion of Mr. Hustler, who represented the bank; and the following were appointed to act as a committee of inspection:—Messrs. G. W. Laughton, Hustler, Thomas Paton, H. W. Johnson (Messrs. R. Johnson & Nephew, Ltd.), and H. Jowett (Messrs. S. W. Whaley & Co.). The remainder of the proceedings were of a formal nature.

Book Notices.—"The Principles of Alternating Currents." By E. T. Larner. London: Crosby Lockwood & Son. 1908. Price 4s. 6d. net.

"Supplement to Ross's Coder." By C. E. Ross. Calcutta: Thacker, Spink & Co. Price 8 annas.

Liquidations.—Mevagissey Electric Lighting Co., Ltd.—A meeting is to be held at the Town Hall, Mevagissey, Cornwall, on October 2nd, to hear an account of the winding-up from the liquidator, Mr. James Kemble.

Commercial Electro-Chemical Analysis Co., Ltd.—Creditors are required to send particulars of claims by September 30th to the liquidator, Mr. A. C. Roberts, 9 and 10, Pancras Lane, E.C.

LIGHTING and POWER NOTES.

Aberdeen.—The accounts of the electricity department for the last financial year, show that the total revenue amounted to £45,372, made up as follows:—Sale of energy by meter, £29,711; public lighting, £2,447; Corporation traction (less £90, the difference between the amount charged and the actual cost), £9,664; and suburban traction, £1,379—a total of £43,203; rents and fan duties, £244; hire of motors, £1,345; and attendance on harbour and other arc lamps, £578. The expenditure under the ordinary account amounted to £22,602, leaving a balance of £22,769 to be carried to net revenue account. The balance was disposed of as follows:—Interest on mortgage and other loans, £8,493; depreciation, £8,136; sinking fund, £5,417; one-fifth of cost of Aberdeen Electricity Act, 1907, £477; and surplus carried to reserve fund, £334. The amount of the reserve fund at July 31st was £13,984. During the year the quantity of electricity generated was 6,106,941 units. The total quantity sold was 5,104,036 units, of which 1,945,862 units went for Corporation traction, 147,167 for suburban traction, 2,708,490 for consumers by meter, and 283,517 for public lighting. The total number of public arc lamps was 202, the same as last year.

Ashton-under-Lyne.—The T.C. has offered to supply energy for lighting the Workhouse at 2d. per unit on a minimum annual consumption of 40,000 units.

Ballyclare.—A proposal for electrically lighting the streets in the Council's area has been put forward by Messrs. Miller, Wilson and Pegg. The capital cost was given as £1,500 to £2,000, and the working cost as 2½d. per unit. The matter is to come before the Lighting Committee, the present lighting being by means of oil lamps.

Banbridge (Co. Down).—The Council of this flourishing town is interested in an electric lighting scheme, and at its next meeting a committee will be nominated for the purpose of conducting negotiations, &c. The place has a very convenient source of power in the Upper Bann, which flows through the town.

Bradford.—In order to encourage the use of electricity for lighting in St. James's Market, the Corporation Electricity Committee has reduced the price of energy to the tenants from 4d. to 2d. per unit.

Bradninch.—The Council has agreed to accept the offer of the Bradninch Electric Lighting Co. to light the town at £25 per annum.

Brighouse.—The T.C. has received from the L.G.B. sanction to a loan of £2,353 for electricity purposes.

Caergwrle.—An E.L. scheme for this place has been prepared by Mr. A. D. Griffiths and submitted for examination to Mr. Pickvance, borough electrical engineer at Wrexham, how reports very favourably on the success of the project.

Canada.—The contract for building the Ontario Government power transmission lines has been awarded to the F. H. McGuigan Construction Co. The line will connect Niagara and St. Thomas in the west and Montreal in the east, over some 293 miles of route. The steel towers, 3,176 in number, are to be supplied by the Canadian Bridge Co. and the Ontario Iron and Steel Co.; over a million pounds of aluminium wire will be supplied by the Northern Aluminium Co., of Shawinigan, and the work is to be completed in 15 months. Some 27 tenders were received, that accepted being for $1,270,000, or a quarter of a million dollars under the Government's estimate.

Trouble has arisen with the Montreal Light, Heat and Power Co. as to the city street lighting. The company requires a higher price before renewing its contract, and it is suggested that an appeal should be made to the Courts to compel it to renew the present contract for two years.

Continental Notes.—Italy.—The English Crown Spelter Co., Ltd., whose mines are at Ponte di Noson, has secured a concession from the authorities of the Province of Bergamo, for a concession to put down a plant to utilise the water power of the River Noseda in the generation of electrical energy for lighting and power purposes.

Application has lately been made to the authorities of the Province of Novara, for a concession to put down a plant to utilise the water power of the River Anzine at Vagna in the generation of electrical energy for lighting and power purposes.

Haslingden.—At the fortnightly meeting of the B. of G. on the 28th ult., a final offer was read from the Rawtenstall Corporation to supply electricity to the workhouse, subject to a five years' agreement, at 3¾d. per unit for the first 15,000 units, and a flat rate of 3d. for additional units, the minimum to be 15,000. The clerk was instructed to reply that the offer of the Corporation was not accepted, and it was decided that steps be taken to obtain the sanction of the L.G.B. to the borrowing of money for the purpose of the generating of electricity at the workhouse.

The Corporation intends to proceed with the adapting of a portion of its destructor premises for the purpose of a generating station, the extra cost to be paid out of the current account, the Corporation having already power to borrow for the necessary machinery.

The T.C. has applied to the L.G.B. for a loan of £7,000 for the provision of electricity plant.

Hastings.—At to-day's meeting of the T.C., Councillor Cox is to propose that the price of current be increased 1d. per unit, or to so adjust the price that the revenue shall be increased not less than £3,000 upon a basis of sale of energy equal to that actually sold during the year ended March 31st, 1908.

Hereford.—For the year ending March last, the total revenue amounted to £4,679, and the surplus, after meeting all charges, to £220. Some 286,391 units were sold, the lamp connections amounting to 26,745 equivalent 8 c.p. The total working cost averaged 1·61d. per unit. An increase occurred during the year in coal costs, and in financial repayments, which had the effect of reducing the surplus as compared with 1906-7.

Malton.—The U.D.C. has approved of a three years' agreement for electrical street lighting by the Northern Counties Electrical Supply Co.

Northfleet.—The scheme for lighting the town by electricity was practically completed on Saturday last, when the new public lamps were switched on, energy being supplied from the Gravesend municipal station. This was the scheme which the Gravesend Corporation resolved to abandon after sealing the contract, but eventually it rescinded the resolution under a threat of an action at law by the Northfleet Council.

Sheerness.—Messrs. Marshall, Fleming & Co. are just completing at Sheerness Dockyard the conversion of three overhead cranes from square shaft to electric drive. Two of the cranes are 20 tons capacity and one of 5 tons, each being driven by three separate motors.

South Africa.—Sea Point (Cape Colony).—At a meeting of the Municipal Council held on August 10th, permission was given to the Cape Town Corporation to erect some sample street electric lamps in the municipality, the streets of which are at present lighted with gas.

Cape Town.—During June last 210,999 units were supplied from the Corporation electric light works, as compared with 189,727 units during June, 1907, an increase of 21,272 units, or 11·21 per cent.; the revenue being £5,483, compared with £4,993, a net increase of 9·81 per cent. For the six months ended June 30th, 1908, the supply of electric energy was 1,028,325 units, compared with 939,653 units during the same period of 1907, an increase of 9·43 per cent. The revenue accruing amounts to £26,519, compared with £24,601, an increase of £1,918, equivalent to 7·79 per cent.

Pietermaritzburg.—At a recent meeting of the Town Council, plans were submitted and a proposal made to replace the existing oil street lamps by incandescent electric lamps. £2,000 would be required as a start, and it is estimated to bring about a saving of £500 per year. The matter was referred to the incoming Council.

South Stoneham.—The R.D.C. has passed a resolution assenting to the application of Southampton T.C. for a prov. order to extend the E.L. mains to the Council's area. The R.D.C. is to have the option of purchasing the undertaking at a stated time.

Ware.—The North Metropolitan Electrical Power Distribution Co., has informed the U.D.C. that it considers that an E.L. undertaking for the town cannot be carried on with profit, and it has, therefore, applied to the B. of T. for the revocation of the E.L. order, 1905.

Wimbledon.—The Electric Lighting Committee of the T.C. has approved a scheme for the improvement of the street lighting. It has decided upon the installation of a 220-volt 50-c.p. metallic-filament lamp in each of the 1,045 lamp-posts in the borough, and the purchase of 155 metallic-filament lamps for the purpose of stock, at an estimated cost of £288, while the estimated cost of the necessary alteration of wiring and fittings is £130 12s.

Wrexham.—A loan of £3,000 for electricity purposes has been applied for by the T.C.

TRAMWAY and RAILWAY NOTES.

Belfast.—At the weekly meeting of the Tramways and Electrical Committee, the town clerk was instructed to have a draft agreement prepared *re* the running powers of the Cavehill and Whitewell Tramway Co. over the Corporation's lines. Thirty-four of the new "Tierney & Malone" automatic point controllers are to be introduced on the Corporation's lines, thereby doing away with the necessity for point boys. This is an Irish invention which is rapidly coming to the front. Three of these automatic controllers have been in use for the past four months, with such good results that the Corporation has placed an order with Messrs. Brecknell, Munro & Rogers for the equipping of the system.

Blackburn.—The T.C. has this week passed a resolution "That the Light Railway Commissioners be requested to confer on the Council, by means of the Blackburn, Whalley and Padiham Light Railways Order, 1908, authority to construct, or contract, for the construction of any railway or railways within the borough, proposed to be authorised by the said order, and to raise or advance money for that purpose. Also authority to enter into contracts with the promoters of the said order to work or to contract for the working of the light railways proposed to be authorised by the said order, or any of such light railways."

Blackpool.—It is expected that in the Bill which the T.C. is promoting in Parliament, powers will be sought for the construction of additional tramways in the neighbourhood of Marton.

Bradford.—It has been decided to accept the terms of the War Office for the hire and purchase of motor-vehicles in case of emergency, and two tramway motor-lorries have been enrolled for that purpose.

The Tramways Committee has decided to equip the whole of the cars with electricity meters. About 100 cars have been so fitted for a considerable time, and the results obtained have led to their extended adoption.

The Tramways Committee has also arrived at an agreement for the through running of cars to and from Leeds on the following conditions: Each undertaking shall operate an equal number of cars, and the surplus mileage shall be paid for by the undertaking in which it is run, on the basis of working expenses. The expenses are to be on a fixed basis, the charges to include the wages of motormen and conductors, cost of car cleaning and oiling, cost of uniforms and badges, and maintenance of cars and compensation. Under each heading the charges are to be on the basis of the average cost per car-mile, according to the last published accounts of the two undertakings. Each undertaking shall be entitled to the whole of the local receipts taken in its own area, but all through fares (which, for adults, will be 6d.) shall be divided (*a*) up to an agreed number equally, (*b*) above the agreed number, in the ratio of the route-mileage traversed on each system, approximately 5½ miles for Leeds and 4 for Bradford. Each undertaking will issue to the other in bulk, tickets suitable for its district, and in its own area each authority will have the whole control of the traffic and of the inspection of tickets. The traffic arrangements are to be in the hands of the general managers of the respective areas, while the employés will be subject to the regulations in force in the district in which they are working. At the end of the first year's running, any matters in dispute may be reconsidered and mutually adjusted, failing which, if it is desired to continue the through service, they must be placed for final agreement in the hands of an arbitrator mutually chosen, or decided by the Board of Trade.

Continental Notes.—GERMANY.—The Prussian railway authorities have agreed to the electrifying of the short sections of railway between Gusten and Stassfurt and Gusten—Bernburg—Kothen, experimentally, power being supplied from central stations in the Magdeburg district. Later, the Magdeburg—Bitterfeld—Leipzig and Halle—Leipzig lines will be converted, the total length being 102 miles. Apart from the improved traffic conditions which the electrified lines will produce, a reason for the conversion is stated to be the poor quality of the locomotive fuel in the district. A large central station is projected on the coalfield, and some two years is suggested as the period of conversion of the railway.

FRANCE.—Some trials are being made at Marseilles with the Mercedes—Electrique—Stoll system of electric motor-'buses, which are operated on the overhead trolley system.

Dundee.—The result of the year's working of the tramways shows that the gross receipts have amounted to £60,572 and the working expenses, including maintenance of lines, to £39,879, leaving a balance of revenue over working expenses of £20,692. This sum has been appropriated in meeting interest, sinking fund and depreciation; £4,000 has been allocated to the fund for renewals, and a surplus of £40 is carried to reserve. The mileage run during the year was 1,281,552, an increase of 118,760 on the preceding 12 months. The return shows an increase of 621,225 passengers, and £2,900 in receipts.

Glasgow.—The City Finance Committee and the Tramways Committee of the T.C. have unanimously agreed to recommend that body to incorporate in the first provisional order promoted by it, a clause asking for Parliamentary sanction to include under the Loans Act the borrowing powers of the T.C. for tramway purposes. In 1895 a scheme having the same object was successfully opposed by the railway companies and certain landowners and house factors. The tramways is now the only department outside the financial unification scheme of the T.C. After consultation with the various local authorities and other parties interested, an arrangement has been come to between the Glasgow T.C.'s committee, and the interested parties in connection with the work of extending the Corporation tramway system from Pollokshaws by Rouken Glen *via* Thornliebank, a distance of about three miles.

Halifax.—On the morning of August 26th, a car ran back down Gibbet Street, owing, it is stated, to the power being cut off suddenly. The passengers scrambled out with little injury to themselves, and the car also, after running back some 500 yards and leaving the track on a curve, was pulled up at the edge of the road undamaged.

Little Eaton.—One of the pioneer tramways in this country, laid with L section plates, between the Kilburn Collieries and Little Eaton, in 1795, has just been closed. The line was laid by James Outram, of Butterley, and was known as "Outram's Way."

Llandudno-Colwyn Bay.—Owing to the exceedingly heavy traffic on the Llandudno and Colwyn Bay Light Railway during August, the company has notified the Llandudno T.C. that additional electricity plant, sufficient to supply three times the present power, must be put down within the next nine months, otherwise the company will be compelled to establish its own power station at Rhos. The cost of the additional plant required is estimated at £20,000, and we understand that the Llandudno T.C. will immediately consider the matter at a special meeting.

London.—The Highways Committee of the L.C.C. proposes that the Council should seek Parliamentary authority in the Session of 1909, for the construction of further new tramways from Harrow Road to Edgware Road (Maida Vale), Farringdon Road to Charterhouse Street; in Hackney, from Mare Street to Wick Road; from Essex Road to Kingsland Road; from Battersea Bridge to Uxbridge Road; and other routes in Battersea and Wandsworth. The cost of these lines would be £403,430, and certain other proposals for converting existing horse tramways bring the estimated total cost up to £710,000.

Manchester.—The Watch Committee has decided to permit another experiment to be made with motor-omnibuses in the outlying districts of the city. The vehicles are to be steam-driven, and the licences will be provisional only for three months. Two years ago petrol 'buses were tried and given up, owing to the opposition of residents and house owners.

New Zealand.—The returns of the Christchurch Tramways for the past year show a revenue of £91,183 and operating expenses amounting to £58,088. The net earnings were sufficient to meet interest and sinking fund charges and to provide £6,075 for depreciation, £6,075 for renewals, and leave a balance of £188.

Rochester.—The T.C. has now completed its system of electric tramways, by the addition of the route from Delee to Borstal. The new route has been made on private ground, the Corporation having purchased a roadway through fields at Upper Delee Farm. Now passengers are enabled to travel from Borstal direct to Gillingham Church, a distance of some six or seven miles without changing cars, and by a slight change can go on into Rainham, some five miles from Chatham.

South Africa.—DURBAN.—The Mayor's minute for the Borough of Durban for year ending July 31st, 1908, in referring to the general progress of the town, mentions that the electric tramway revenue has considerably exceeded the estimate, the figures being £90,000, as compared with £85,610 for the preceding year. The electric light department shows a steady growth of an additional 274 consumers, the total number now being 3,730.

Stechford.—A meeting of the Bordesley ratepayers has passed a resolution favouring the extension of the Birmingham tramways from Bordesley to Stechford Station.

Yarmouth.—A bolt, which had dropped from a preceding car, was responsible for the derailing of a car on an awkward curve, on August 29th. The car after leaving the track ran into the wall of the Yarmouth Gas Co.'s Works, but fortunately the passengers sustained no serious injury.

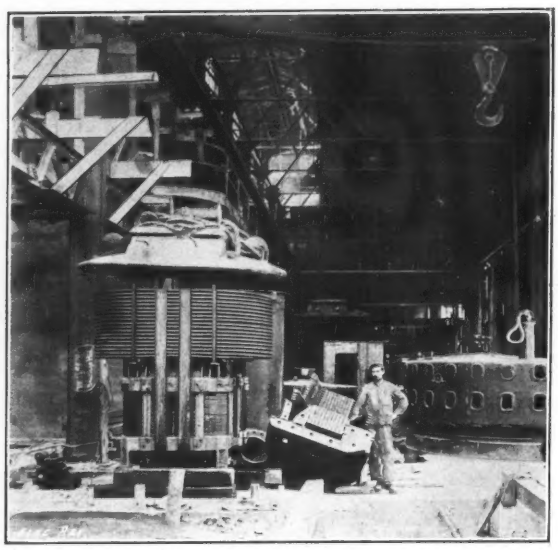
THE NECAXA POWER PLANT, MEXICO.

In our issue of February 15th, 1907, we dealt at some length with many interesting features of the Mexican Light and Power Co.'s work in Mexico. Since that time the company's undertaking has been rapidly developing, so much so, that some 60,000 H.P. of load is now being supplied, jointly by the hydro-electric installation at Necaxa and the auxiliary steam-driven plant in the City of Mexico. With such a favourable result it is not surprising that the company has set to work to develop the remainder of its extensive water-powers, nor that a second power house should be in course of erection, with a view to utilising this water-power and superseding the steam-driven plant. At the present time, reservoirs have been completed at Necaxa, Texcapa, Los Reyas and Laguna, and these have a combined storage capacity of 170 million cb. metres.

View Showing Pipe-Line Construction.

This large storage is of course necessary in Mexico, which, like all tropical countries has a dry and a rainy season, and the rivers of which have a consequently very irregular flow. The Necaxa river, with which the scheme originated, is fed partly from a plateau some 8,000 ft. above sea level, and partly from the slopes that fall abruptly from the plateau towards the east; its flow during the dry season is only 1 cb. metre per sec., but this is increased during the rainy season to as much as 148 cb. metres per sec., and of course the same holds good for

Interior of the Necaxa Power House, Showing the 5,000-kw. Wheel-Driven Generators.



Constructional View, Showing 2,000 kw. Transformer.

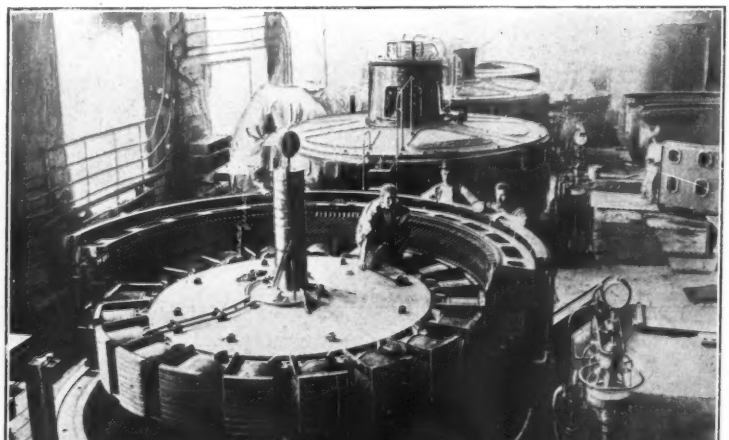
other streams which have been impounded in the reservoirs mentioned previously.

The Necaxa reservoir is fed both by the river of that name and by the Tenago river, which was diverted through a tunnel with this object in view. From the reservoir, two 8 ft. dia. pipe lines, subsequently reduced to 6 ft. dia., feed into two receivers, from which again six 30-in. dia. pipes lead into the basement of the power house.

The total head of water is 1,350 ft., giving a pressure at the wheel nozzles of 580 lb. per sq. in. Full details of the hydraulic works were given in our earlier article.

The power house is an iron and concrete structure with a galvanised roof supported on steel trusses; its construction and that of the pipe lines involved many difficulties, as the nearest railway station, Carmen, on the Hidalgo line, was 30 km. from the constructional camp at Mesa.

For the transport of machinery and building material the company built a narrow gauge railway through the mountains, but as the power house is in a ravine some 2,000 ft. below the camp, it was also necessary to fit up machinery to lower the material down to the site. At the power house, each pipe is fitted with a gate valve and by-pass as it enters the wheel pit; the wheels, six in number, were supplied by Escher, Wyss and Co., and are of the impulse type, 2·90 m. in dia. carrying 24 cast-steel buckets, fed by two rectangular regulating nozzles set diametrically opposite each other.



Siemens-Schuckert 5,000-kw. Generator under Construction.

The nozzles are controlled by an Escher, Wyss universal governor, which is also coupled to the by-pass valve and opens the latter in case of the sudden closing of the nozzles, thus guarding against dangerous shocks in the pipe lines.

A 14-in. vertical shaft carries both wheel and generator, supported in an oil step bearing between the wheel and rotor.

Each machine is provided with a three-throw oil pump, which maintains an oil pressure of 360 lb. per sq. in., in both step bearing and governor, this being sufficient in the case of the former to ensure a 3 mm. film of oil to support the revolving mass.

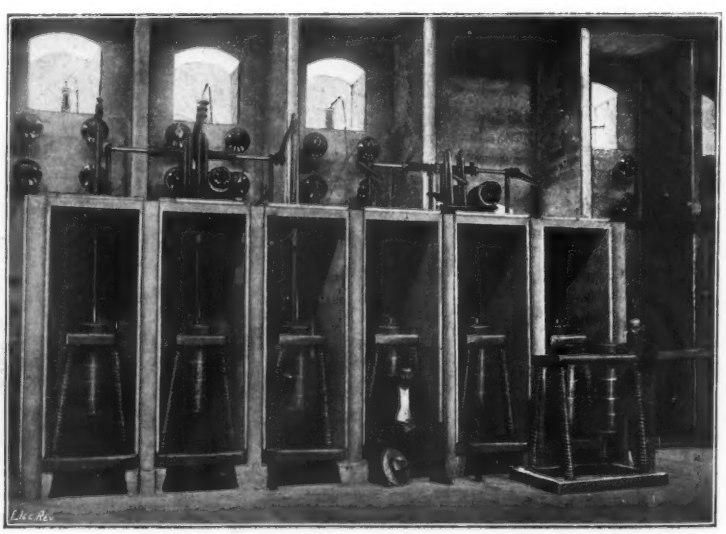
The generators are of the revolving field type, made by Siemens-Schuckert, each having a capacity of 5,000 kw., and supply three-phase current at 4,000 volts pressure and 50 cycles. Energy for excitation is obtained from two 200-kw. induction motor-generators, the generators being wound for 100 volts pressure, and fitted with commutating poles. Each motor-generator is also coupled to a Pelton wheel fed from an independent 10-in. dia. pipe line, which also supplies water for operating the oil pumps.

Normally, the exciters are driven by the Pelton wheels, the induction motors floating on the bus-bars.

This is advisable, as the nozzles of the wheels of this size, running under a head of 1,400 ft., have a very small opening, where the presence of a small quantity of grit or foreign matter in the water would immediately result in varying the speed of the set. On the other hand, if the exciters depended on bus-bar current only, there would be a risk of lowering the speed, or even blowing fuses in the event of a heavy short-circuit on the system.

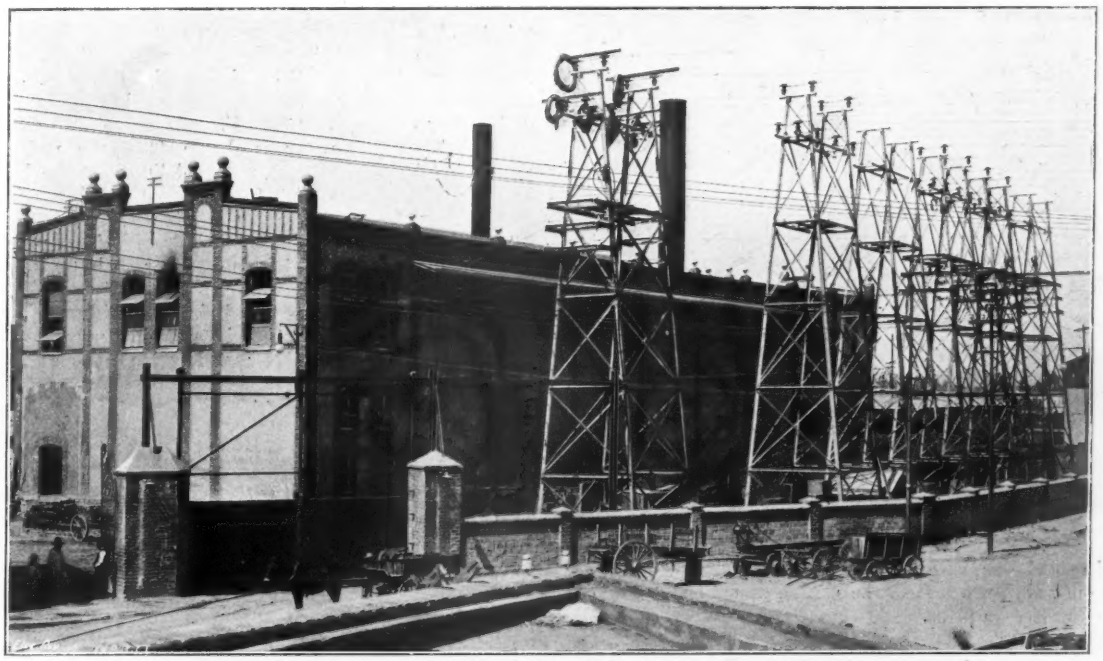
The generators supply 15 single-phase oil-insulated water-cooled transformers, made by the G.E. Co. (U.S.A.), which step up the generated pressure to 60,000 volts.

The transformers, each of 2,000-kw. capacity, are arranged in banks of three, delta connected, a bank being



The 60,000-volt Oil Switches.

coupled to each transmission line, leaving one bank as spare. These transformers are placed in a fireproof compartment under the switch gallery, each transformer being connected to a pyrometer on the gallery, with a view to indicating the temperature to the attendant.



The Distributing and Steam-Driven Station at Nonoalco, City of Mexico.

The switch gallery extends along one side of the building, and carries the 4,000 and 60,000-volt switches, mounted in fireproof compartments.

The switches are of the oil-break type, fitted with time-limit relays and provided with isolating links, and are operated from a bench control-board situated in the centre of the gallery.

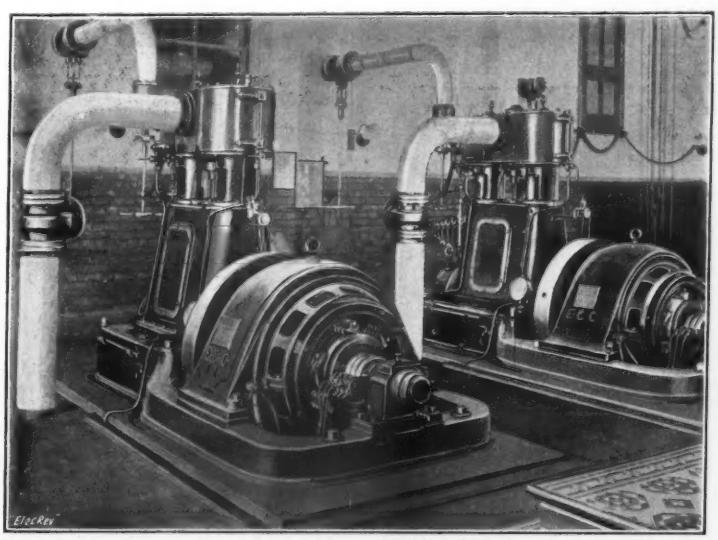
Vertical panels behind the bench carry all the indicating instruments and meters necessary for the operation of the plant.

The 4,000-volt connections between the generators and transformers are of insulated cable run separately in conduit; the 60,000-volt leads from the transformers are bare copper, carried on tower insulators under the switch gallery, to the switches controlling the transmission lines. The latter leave the power house through rectangular vents, a lightning arrester of low-equivalent type being coupled to each cable just inside the building.

The four 60,000-volt transmission circuits (details of which were given in our earlier article) are carried on two galvanised steel tower lines, arranged for the most part with spans of 500 ft., but increasing, with higher towers, up to 1,500 ft. in crossing valleys.

These run to the Nonoalco station in the city of Mexico, some 94 miles away; and two circuits are continued in a westerly direction, some 75 miles, to the El Oro and Esperanza gold mines.

The Nonoalco station is the distributing point for all the plants, and from it are run the feeders for the Mexico Tramway Co.'s sub-stations and the power and lighting circuits; it contains, in addition to 16 1,800-KW. step-down transformers and the necessary switchgear, some 7,000 KW. of steam plant, and this is supplemented by a further 3,000 KW. of steam plant in the San Lazaro station.

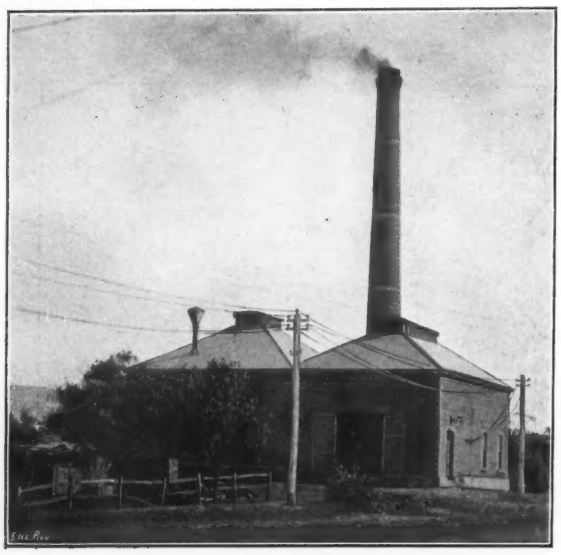


Northam Electricity Works, W. Australia: The Generating Plant (see page 382).

Some 150 miles of electric tramways, with 300 passenger and freight cars, are operated by the company, and the local light and power distribution comprises over 100 miles of underground mains.

The El Oro sub-station contains similar step-down transforming plant to that at Nonoalco, for supplying energy to 500-KW. synchronous motors, which operate the stamp mills at the mines; a further transformation to 440 volts is made for motors of 50 H.P. and under. The second hydro-electric plant, which is being constructed, will duplicate the power of the Necaxa plant, and will be situated some 3 miles away from it, at the junction of the Necaxa and Laguna rivers. The Laguna reservoir previously mentioned will supply this plant, the water supply being obtained from the Laguna river; and from the rivers Zacatlan and Losreis, which will be diverted for the purpose.

The diversion of the Zacatlan will entail the damming of the stream and construction of 25 miles of canal and tunnel works.

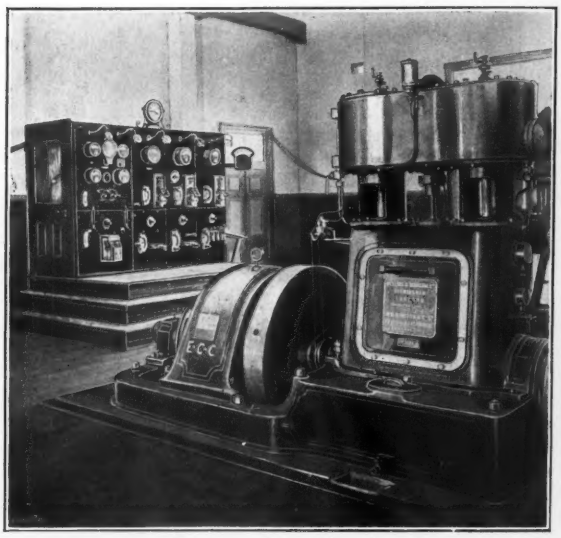


Exterior of the Northam Electricity Works, W. Australia.

In conclusion, we are indebted to Mr. Alexander McKee for our views, which show the constructional features of the existing Necaxa plant.

ELECTRICITY IN AN AUSTRALIAN COUNTRY TOWN.

The town of Northam, Western Australia, situated about 90 miles from Perth, in the centre of the agricultural districts, has a population of some 4,500 inhabitants and an enterprising and progressive town council. Some years ago a start was made in the direction of electricity supply with two small single-cylinder engines and dynamos installed in a shed behind the Town Hall, intended principally for street lighting purposes, but with the steady growth in the prosperity of the town, a demand arose for current for private lighting and power which compelled the Council to embark on a larger scheme. Recently, therefore, a central site was secured, and a contract entered into with Messrs. W. H. Kidston & Co., Ltd., Perth, for the erection of new works thereon. The power house is a brick building 70 ft. × 45 ft., in two bays, for the boiler house and engine room respectively, and is laid out for the accommodation of four boilers and three generating sets, of which two of the former and two of the latter are at present installed. The boilers are of the Babcock & Wilcox standard pattern, each having 1,426 sq. ft. of heating surface, and are constructed for a working pressure of 160 lb.; the furnaces are designed for burning wood fuel. Each boiler is fitted with an internal superheater of 248 sq. ft. heating surface, designed to impart 150° F. of superheat to the steam. The feed water is drawn from the mains of the Coolgardie water scheme, and is delivered to the boilers by two duplex direct-acting feed pumps through a Babcock and Wilcox feed-water heater capable of dealing with 10,000 lb. of water per hour. Ample draught is secured by a circular brick smokestack 5 ft. in diameter, and 100 ft. high. The whole of the steam and feed pipes are of seamless mild steel, and were made by Messrs. Babcock & Wilcox, who also supplied the exhaust, blow-down, and drain pipes and valves. The engines are of the Belliss & Morcom two-crank compound type, of standard design, and each is capable of developing an output of 145 B.H.P. at 475 R.P.M., when



Switchgear, Northam Electricity Work.

The Boiler House, Northam Electricity Works.

supplied with steam at 150 lb. at the top valve. To each engine is coupled a D.C. generator designed for a normal output of 100 KW. at 460 volts pressure. The generators are six-pole shunt-wound machines, with auxiliary commutating poles, and were made by the Electric Construction Co. Each is fitted with a balancing arrangement, consisting of slip-rings and choking coils, for working on a three-wire distribution system. The switchboard is also of the latter company's make, and comprises eight panels of enamelled slate, equipped with Everett, Edgcumbe moving-coil instruments, and Dorman & Smith circuit-breakers; there are also provided a Bristol recording voltmeter, and a Duncan watt-hour meter. The engine room is spanned by a hand-travelling crane made by Messrs. Holt & Willetts. The engines were worked non-condensing at first, owing to the fact that although the site is on the banks of the river Avon, the latter is dry during the greater part of the year; a weir, however, has now been constructed, which provides a large sheet of water in the town during the whole of the summer, and a condensing equipment drawing the circulating water from this source has been provided.

The whole of the plant was supplied by Messrs. W. H. Kidston & Co., Ltd., and erected under the supervision of their engineer, Mr. E. L. Webb, A.M.I.E.E., to whom we are indebted for the photographs here reproduced. The architect was Mr. C. H. Whiteford, and the builder Mr. R. Millington. Mr. R. Macdonald is the Council's electrical engineer.

TELEGRAPH and TELEPHONE NOTES.

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Durban.—The Telephone Department for the year ending July, 1908, shows an addition of 298 subscribers, the total number being 1,242; the average number of calls per day per subscriber equals 11. The revenue for the year amounted to £13,000.

Manchester.—Public telephone call offices have been opened in 14 branch public libraries belonging to the Corporation.

Morocco.—The Spanish Administration is about to lay a submarine telegraph cable, having a length of 53·636 kilometres, between Chafarenas, on the north coast of Morocco, and Nemones, in Algiers. The cable, for the present, will only be used for traffic exchanged between Spain, Canary Islands, Spanish possessions in North Africa, Tangier, Algiers, and Tunisia.

German Cables.—A new telegraph company has been formed under the title of the German-South American Telegraph Co., Ltd., with its headquarters at Cologne, the special object of which is to lay and work submarine cables from Germany *via* Teneriffe or Liberia to Brazil and to the German Colonies in West and South-West Africa. Subsidies, which the German Government has consented to grant, will ensure the payment of interest and sinking fund on the bonds to be issued by the company, as well as a sufficient rate of interest on the share capital. It will be remembered that the German Co., owning the cable between Emden and Vigo, in May of last year obtained a concession from the Spanish Government to land a cable at Teneriffe on condition that it stretched direct from Emden to that island without touching at any intermediate point. This reservation was apparently made to safeguard the interests of the British companies whose cables land on Spanish territory, and although it involved the laying of a much heavier type and greater length of cable than was anticipated by the German company, the condition was accepted. In 1902 it was rumoured in the Press that Germany was planning the laying of cables from the Azores to Dutch Guiana in order to be free of dependence on English wires in time of war. In view of the Dutch-German joint cable enterprise in the Far East this scheme was looked upon as probable. The Western Telegraph Co. laid a cable from St. Vincent to Fayal in 1906, thus enabling their traffic to be dispatched more expeditiously to America.

The *Financial News* states that the capital has been fixed at 4,000,000 marks, but it will be increased from time to time, in proportion to the progress of the business, by issues of new shares or debentures. It has been stipulated that two-thirds of the board of directors must be of German nationality and must reside in Germany. The electrical manufacturing firm of Felten, Guilleaume and Lahmeyer, who originally obtained the concession and passed it on to the new company, will supply and lay the new cable.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
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Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Las Palmas—Arrecife	May 18, 1908 ..	..
Pera-Dardanelles	May 20, 1908 ..	..
Sierra Leone-Accra	May 28, 1908 ..	..
Kwandang-Menado	Aug. 5, 1908 ..	..
Djedda-Souakim	July 27, 1908 ..	..
Assab-Massouah	July 28, 1908 ..	..
Cadiz-Teneriffe	Aug. 20, 1908 ..	..
Cotonou-Lagos	Aug. 29, 1908 ..	..

The violent storm at the beginning of this week wrought much damage to overhead telegraph and telephone lines, and delays occurred in transmission to and from almost all parts of the United Kingdom, as well as Germany, France and Austria.

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Wireless Telephony.—Dr. Lee De Forest has made arrangements with the French Government to use the Eiffel Tower for the purpose of establishing telephonic communication between Paris and New York, the American antenna being erected on the Metropolitan Life Insurance Co.'s tower, which is 680 ft. high. He believes that his apparatus will have a radius of communication of 1,000 miles, and he hopes that improvements now in progress will increase this sufficiently to make possible trans-Atlantic communication. The great height of the antennæ will enable him to use waves so long that to ordinary apparatus they will be inaudible.

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Australia.—Adelaide.—October 2nd. G.P.O. Power plant for charging accumulators for telegraph purposes.

Adelaide.—November 20th. The City Council requires tenders for the supply and erection complete of a refuse destructor, electric lighting plant for same, &c. Particulars may be obtained from the Agent-General for South Australia, 1, Crosby Square, Bishopsgate Street Within, E.C.

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South Australia.—October 21st. Tenders will be received at the office of the Deputy Postmaster-General, Adelaide, for a power plant for charging accumulators for telegraph purposes at the General Post Office, Adelaide, as per specification No. 228. Specifications can be seen at this office.

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Canada.—The Ontario Hydro-Electric Power Commission will call for tenders shortly for transforming stations. The stations will be 12 in number, and will be built at Niagara Falls, Dundas, Toronto, Brantford, Woodstock, London, Guelph, Preston, Berlin, Watterloo, Stratford, St. Mary's and St. Thomas.

Castlebar.—September 7th. The lighting of 52 public lamps by electricity, gas, acetylene gas, or other illuminant for the U.D.C. The lamps have to be lighted by 15th inst. Deposit 10s. Apply Clerk to the Council, Courthouse, Castlebar.

Dublin.—September 4th. 500 single-phase and 100 three-phase A.C. meters for the Corporation. See "Official Notices" August 21st.

September 4th.—Boiler plant, &c., at Pigeon House generating station for the Corporation.

September 11th.—Electric lighting works at the State apartments, Dublin Castle. Specifications, &c., to be seen at the office of H. Williams, Secretary, Office of Public Works, Dublin.

East Indian Railway.—September 16th. 600-KW. three-phase alternator; gas-engine alternators and equipment See "Official Notices" August 28th.

Egypt.—October 29th. The Ministry of the Interior wants tenders for the installation of electric lighting in the town of Zagazig, in accordance with specifications and plans that may be inspected at the offices of the above Ministry at Cairo.

Germany.—POSEN.—Tenders are about to be invited by the municipal authorities for the extension of the electric lighting undertaking, at an estimated cost of £75,000.

ENSHEIM (ZWEIBRUCKEN).—The municipal authorities are about to invite tenders for the construction of an electric tramway in the town.

LEIPZIG.—September 10th.—The municipal authorities require tenders for equipment and stores for their electricity stations. The Burgomeister will supply particulars if reply-paid application is made.

September 25th. The "Finanzdeputation" wants eleven electric-travelling cranes. Conditions of tender may be purchased for 15 marks, at Sekretariat II, "Finanzdeputation," Hamburg.—*B. of T. Journal.*

September 28th. The State Railway Administration, St. Johann Saarbrücken, invites tenders for the supply and fixing of an electric turntable for locomotives of 20 metres dia. Conditions, plans and form of tender may be obtained at the above-mentioned Administration, Room No. 218, on payment of 5 marks (not in postage stamps).—*B. of T. Journal.*

Hull.—September 10th. The Grammar School Committee of the Corporation is inviting tenders for the electric light installation, fittings and fans required at the additions to the Hull Grammar School. Specifications can be obtained at the office of Mr. J. H. Hirst, the City Architect.

Ilford.—September 22nd. Overhead travelling crane for the U.D.C. See "Official Notices" to-day.

London.—L.C.C.—September 8th. Cables, cable-boxes, &c., for East Greenwich generating station and Woolwich Road car depôt; electric wiring for car depôt; switchgear; and six 500-KW. and one 150-KW. motor-generators, for the L.C.C. See "Official Notices" August 7th.

Merthyr Tydvil.—September 19th. Messrs. Hills, Plymouth & Co., Ltd., invite tenders for stores for electric appliances for their collieries for 12 months ending September 30th, 1909.

Russia.—September 14th. The Town Clerk of Odessa (Upiawa) requires tenders for a concession to erect and work a power and lighting supply. A central station of a minimum of 6,000 H.P. is to be erected and equipped.

Salford.—September 14th. Lighting and power feeder and distributor pillars for the Electricity Committee. See "Official Notices" August 28th.

Sligo and Leitrim.—September 5th. The Board of Governors of the District Lunatic Asylum wants tenders for lighting the Institution, either electrically or with petrol gas (about 450 lights). Messrs. Anthony Scott & Son, architects, 49, Upper Sackville Street, Dublin.

Spain.—HUELVA.—September 29th. Two electrically-driven cranes and tip wagons. Junta de Obras del Puerto.

VILLANUEVA DE CORDOBA (Province of Cordoba).—The municipal authorities have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

Stoke-upon-Trent.—September 8th. Water-cooling apparatus for the Electricity Committee. See "Official Notices" August 28th.

CLOSED.

Bolton.—The Electricity Committee last week had submitted to it 18 tenders for coal, and decided that tests should be made of sample loads obtained from Messrs. Andrew Knowles, Ltd., Messrs. Fletcher, Burrows & Co., Messrs. J. Roscal and Sons, and Messrs. A. Bromley & Sons. The Committee has also accepted the tender of Messrs Waring & Co. for the supply of cylinder oils

Birkenhead.—The tender of Messrs. Hinson & Co., Argyle Street, Birkenhead, has been accepted for the electric lighting installation at Hamilton Square Congregational Church.

Eccles.—The Corporation has decided to accept the tender of John Spencer, Ltd. (Wednesbury), for the installation of circulating water piping at the electricity works, for the sum of £258. The tender of Messrs. Ferranti, Ltd., to supply and erect a switch panel has also been accepted.

Edmonton.—At the last meeting, the Board of Guardians accepted the tender of Messrs. Tilley, at £376 7s. 8d., for the electric lighting installation at the Nurses' Home.

Glasgow.—Messrs. Johnson & Phillips, Ltd., have received an extension order from the Clyde Navigation for the Rothesay Dock, for insulators.

The T.C.'s Tramways Sub-Committee on Works and Stores has recommended the acceptance of the following:—Welsh slates, Johnston, Ltd.; German silver tape, British Insulated and Helsby Cables, Ltd.

Hull.—The Corporation has accepted a tender for the supply and erection of a 900-KW. D.C. generator, with Belliss engine for the tramway department, at a cost of £5,926.

Lochgelly.—The Lochgelly Iron and Coal Co. have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and erection of shaft and inbye cables for the Lochgelly Pits.

Manchester.—The Electricity Committee has placed with Veritys, Ltd., the order for ½, 2, 7 and 10-H.P. motors of the "Aston" interpole type, and for ½, 1, 2, 3 and 7-H.P. improved "Aston" starters, both contracts being for two years.

The Tramways Committee has concluded a contract with Messrs. Mather & Platt for the installation of automatic sprinklers at the Hyde Road and Princess Road car-sheds.

South Africa.—JOHANNESBURG.—Our Durban correspondent writes stating that at the last meeting of the Town Council the tenders for the additional power station plant were the subject of a very heated discussion. The meeting had to be adjourned, and resumed the following day, on account of the arguments brought forward by those in favour of the reciprocating type of engine and by those who favoured the turbine. The Committee recommended the following acceptances:—

(1) C. A. Parsons & Co., tender for an 1,800-KW. turbine, coupled to two 900-KW. D.C. generators, including erection, switchgear and spares, to be erected complete by December 20th, 1908, £10,470.
(2) C. A. Parsons & Co., for surface condensing plant for the above set, to be erected in 34 weeks from date of order, £2,985.
(3) Reunert & Lenz, for Babcock & Wilcox boiler, with superheater, flue and mechanical stoker, erected in 18½ weeks from date of order, £3,515.
(4) Stewarts & Lloyd, for the supply and erection of steam pipes and fittings for the above plant, to be erected within 18½ weeks from date of order, for the sum of £488 3s. 3d.
(5) That £6,850 be authorised for extending the engine and boiler rooms, with alterations to pipes, cooling tower, circulating pipe and pond, and that tenders for such work be called forthwith.

An amendment was, however, brought forward regarding Clauses 1 and 2, as follows:—

(1) Reunert & Lenz, for a 1,000-KW. Belliss & Morcom engine and A.E.G. generator with balancing arrangement, to be delivered and erected in 18½ weeks from date of order, for a sum not exceeding £11,174, less £205 for spares.
(2) Reunert & Lenz, for condensing plant for the above set, to be delivered and erected within 18½ weeks from date of order, for the sum of £2,164.

On being put to the vote the amendment was carried, subject to the approval of the Finance Committee, and the other clauses stand as in the recommendation.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERCRAVE (near SWANSEA).—New premises for Co-operative Society. Secretary, Co-operative Society, Abercrave.

ABERDARE.—New boys' school, outbuildings, &c., at Godreaman, near Aberdare. T. Roderick, architect, Clifton Street.

ABERDEEN.—Fish meal factory for John T. Kindness, fishcurer, at Ferryhill.

ABERDEENSHIRE.—New house on Boyndlie Estate for J. Munro. Joseph Blake, New Pitsligo.

ADLINGTON.—Council and Church of England Schools.

ALNWICK.—Alterations to the Town Hall. R. San, architect, Alnwick.

APPLEBY.—House, near Gallows Hill, for Thomas Slack; alterations and additions to Liberal Club, Boroughgate.

ATHERTON.—Reported developments pending at local collieries for Hulton Collieries Co., Ltd., Chequerbent, Bolton.

BAKEWELL.—Bungalows, Bakewell district and Blackledge.

BALLYWARD (BANBRIDGE).—New dwelling house, J. Harold, Ballyward, Banbridge.

BARGOED (near CARDIFF).—House, Heol Ddu, for Miss Ruth Jenkins; vicarage house, for Rev. T. Richards; machine and cook shop, for Guy and Sons; workshop, for Morgan James, Maesycwmmer; villa, for Idris Leyshon; houses, at Deri, for Wm. Morris, Bargoed.

BARNSLEY.—Four new classrooms, and renovations to the Pogmoor and Gawler Wesleyan Church. W. T. Turner, architect, Market Hill, Barnsley.

BARNSTAPLE.—Houses, Carlyle Avenue, for J. Rice; Sticklepath Hill, for W. Slee & Son; Kingsley Avenue, Yeo Vale, for J. Hill.

BARROW.—Alterations (including new balcony) to Victoria Hall, Grange-over-Sands, for U.D.C. H. T. Fowler, architect, 6, Cornwall Street, Barrow.

BARTHOL-CHAPEL (ABERDEENSHIRE).—Improvements to church and manse.

BATLEY.—E.L. installation at premises for the Co-operative Society; W. H. Childe, secretary.

BECKENHAM.—Additions to residence (£1,380). G. St. Pierre Harris, architect, 8, Lawrence Pountney Hill, Cannon Street, E.C.

BEDLINOG (TREHARRIS, GLAM.).—Twenty houses for the South Wales Estate Co.

BEDWELLTY (MON.).—Nine houses, Garfield Street, Blackwood, for the Garfield Building Club.

BEXLEY.—Eleven houses, Wickham Lane, for Burtwell & Edwards; houses, Freta Road, for Clark, Parry & Walter.

BERKHAMSTED.—Houses, Ellesmere Road, for G. B. Tutt & Co.; new St. Michael's Church, Sunnyside.

BIRMINGHAM.—New Evesham secondary school (£8,653); H. T. Buckland and Haywood-Farmer, architects, Birmingham. New secondary school at King's Norton (£14,350); Pritchard & Pritchard, architects, Kidderminster. New school to accommodate 740 scholars, at Halesowen (£7,250). New elementary school to accommodate 400 boys, Colley Lane, Cradley; also extension of Council school. Proposed new schools at Malvern Links, Stourbridge and Orchard Lane; Mr. Rye, County architect. Extensions to Hanley Castle Grammar School (£2,500). New fire station at corner of Albion Street and Legge Lane; Thomas G. Price, architect, Union Chambers, 63, Temple Row.

BISPHAM (near BLACKPOOL).—Semi-detached houses, Cavendish Road and Frederick Street, J. Twelves; houses, for S. Midgley and N. Tilling, Red Bank Road.

BLACKBURN.—New public hall (to seat 3,500); quarter sessions court, police station, police court, and elementary school, at Blakey Moor.

BLACKPOOL.—Houses, Roseberry Avenue, for John J. G. Hall; Pedder's Lane, for R. F. Lees and J. W. Cardwell; Portland Park, Whitegate Drive, for Fred. Ayre and Geo. Buckley; Sherbourne Road, for R. Worthington; houses and shops, Bloomfield Road and Central Drive, for John and Aloysius Robinson; model village to be laid out off Warbreck Hill Road; Borough Engineer, Blackpool.

BOLLINGTON CROSS (MACCLESFIELD).—New church (nearly completed).

BOLTON.—House and shop, Brandwood Street, and 15 houses, Blackledge Street, for W. & J. Leigh; house and workshop, Manchester Road, for J. E. Johnson; alterations at Kay Street Arms, Kay Street, for T. E. Smith & Sons.

BRECON.—Conversion of Congregational College to Free Church Institute for Brecon Council. Rev. D. Griffiths, secretary of the Council.

BRIGHTMET (near BOLTON).—Colliery developments. S. Scowcroft & Sons, Rosehill Collieries, Bolton.

BRIXWORTH.—New bakery for the Co-operative Society.

BURNHAM (ESSEX).—House and workshop, Station Road, for King and Hines.

BURNLEY.—New Catholic Church (£3,800). J. B. Holt, architect, Manchester; Smith Bros., builders, Eastham Place, Burnley.

CARDIFF.—Re-building premises, 18 and 19, Church Street, for Cross Bros., Ltd. Veal & Sant, architects, Cardiff.

CARRANBAY (Co. CLARE).—New R.C. Chapel. O'Mulley and O'Rourke, architects, Limerick.

CAVAN.—New Town Hall. Thomas McGuiness, clerk of the Council, Cavan.

CHANDLER'S FORD (EASTLEIGH, HANTS.).—House for Mr. Hedges.

CHIPPENHAM.—New Wesleyan Methodist Church at Monkton Hill.

COVENTRY.—Lighting of St. Michael's Church by electricity (£80).

CRAIGO (FORFARSHIRE).—Rebuilding spinning mill. Mr. Wilkie, Craigo.

CROMPTON (LANCS.).—Houses, Market Street, for Mr. Level.

CYMMER (PORT TALBOT).—Alterations and additions to Workmen's Hall. T. John, 10, Maesteg Road, Cymmer.

DARTFORD.—Proposed Municipal Buildings. T. E. Tiffen, surveyor to the U.D.C.

DARWEN.—New School, Suddle Road, for the Education Committee.

DAWDON COLLIERY.—New Primitive Methodist Church and Schools.

DAWLISH.—Rebuilding Post Office, destroyed by fire.

DEAL.—Detached residence, St. Leonard's Road. G. H. Denne & Son, builders, 7A, Queen Street, Deal.

DONCASTER.—Workmen's dwellings, High Fisher Gate, for the T.C. Jenkinson & Burton, builders, Apley Road, Doncaster. New bridge over Great Northern Railway level crossing; contract leased to A. Arnold & Son, Doncaster, for £47,790.

DROYLSDEN (near MANCHESTER).—New sewage works (£12,000) to be commenced forthwith. Local District Council.

DUDLEY.—Eye infirmary to be transferred from Guest Hospital to new building, also improvements to Guest Hospital.

DUMFRIES.—New United Free Church in centre of town.

DUNBAR.—New rectory and church rooms for St. Anne's Episcopal Church (£2,000).

DUNBEATH.—New United Free Church and manse.

DUNDEE.—Proposed new quarters for Artillery for Dundee Territorial Association (£7,000). The Secretary, Territorial Association, Dundee. Reconstruction of waste store, for J. H. Knuck, Dens Road; villas for Alex. Lickely, Jedburgh Road; alteration to school for the Sisters of Mercy, at Lawside Road.

DUNFERMLINE.—New premises, Queen Anne Street. The Manager, Co-operative Society, Dunfermline.

DURHAM.—Aged miners' homes; J. Hopper, secretary, Durham Aged Mineworkers' Homes. Gift of Cochrane & Co., Ltd., New Brancepeth Colliery.

EASINGWOLD.—New Salvation Army Hall. A. Gordon, architect, London; J. Walker & Sons, builders, Easingwold.

EASTBOURNE.—Two houses, Roseberry Avenue, Hampden Park; W. J. Cole, builder; A. Chandler, architect. Five houses, Huggett's Lane, Willingdon; L. C. Stevenson, builder; A. H. Burtenshaw, architect. House, Brassey Avenue, for H. Sisley. Alterations and additions to 1, Edgeland Terrace, Hampden Park, for Baynes & Sherbourne; C. M. Wood, architect. Two pairs of houses in Brassey Avenue, Hampden Park, for the Eastbourne Artisans' Dwellings Co., Ltd.; Mitchell & Lord, architects. Proposed alterations to Red Lion Inn, Willingdon, for the Southdown and East Grinstead Breweries, Ltd.; W. Bussey, surveyor.

EBBW VALE.—New Church of St. John, Newtown (£4,500). G. E. Halliday, architect, Ebbw Vale Building Co., builders.

ECCLES.—Houses, Egerton Road, Monton, for Mr. Lomax; Clifton Road and Monton Road, for W. A. Edey; premises at Monton for Burgons, Ltd., grocers, Manchester; T. J. Bushell, architect, 18, John Dalton Street, Manchester.

ELLAND.—Conversion of premises, junction of Timber Street and Southgate, into General Post Office, for the executors of Mrs. M. A. Newsome. Five houses, Workhouse Lane; F. F. Beaumont, architect, Southgate Chambers, Halifax.

EXETER.—Extensions to Hele's School (£9,000).

FARNWORTH.—Important extensions to St. Thomas Schools. H. Littler, county architect, Preston.

FARTHINGSTONE (NORTHAMPTONSHIRE).—New schools for the Brackley Rural District Council.

FLEET (HANTS).—Two houses, High Street, for A. and W. Goddard.

FLINT.—Factory for the British Glanzstoff Manufacturing Co. (50 acres).

FRYSTON (near CASTLEFORD, YORKS.).—Developments (new engine houses, &c.) for Fryston Collieries, Castleford.

GELLIGAER.—Houses, Rhigos, for Gwilym Morgan; Pontlottyn, for G. Rowe, Bargoed.

GLAMORGAN.—New schools at Hendre, Penyrheol, Caerphilly, and Fforestfach (Swansea); additions to schools at Skewen, Cadle, Radyr, Rhydygwern and St. George. T. Mansel Franklin, clerk to County Council, Cardiff.

GOLCAR (YORKS.).—Houses, Stoney Lees, for J. Beaumont; wellhouse, for Sarah Ann Pearson.

GRASSINGTON (SKIPTON).—New Shippon. George Pattinson, Grassington.

GRAVESEND.—Probable erection of large paper factory on the Byoliffes Estate by the Amalgamated Press, Ltd., 24, Tudor Street, London, E.C.

GUILDFORD.—Extension to the County Hospital Nurses' Home (£1,500).

HALIFAX.—Houses, St. Bevan's Road, for Shaw Bros.; Trimmingham Lane, for E. & P. Wadsworth; St. Anne's Road, Skircoat, for Wm. and E. Richardson.

HASLINGDEN.—Bakehouses at workhouse for Board of Guardians.

HIGH WYCOMBE.—New premises, Church Street, for Lipton's, Ltd.

HINDLEY (near WIGAN).—New church in connection with Hindley Church (£400).

HITCHIN.—Mansion for J. C. Priestley, K.C., Offley Holes, Hitchin.

HOYLAND (YORKS.).—Houses, King Street, for James McPartlain.

HUDDERSFIELD.—New Wesleyan Church at Sheepridge. Garside and Pennington, architects, Pontefract.

HYDE (CHESHIRE).—Probable re-erection of works at Newton Bank (after fire) for the Calico Printers' Association.

ILFORD.—Houses, Kinfauns Road, for A. Cameron Corbett, M.P. (E. T. Dunn, architect, 20, Mansfield Road, Ilford); Albert Road, for P. E. Brand; Glencoe Avenue, for F. W. Hitchcock; motor house and store, The Laurels, Aldbridge Road, for G. Sharpe; six shops and house premises, Loxford Parade, Ilford Lane, for D. T. Baker; extensions to the electricity works for U.D.C. (£2,048). Myall & Upson, builders, Ilford.

ILMINSTER.—Additions to Ditton Street Schools. Small & Son, builders, Taunton.

INVERGOWRIE (FORFARSHIRE).—Proposed Church Hall. Rev. Mr. Davidson, The Manse.

ISLE OF THANET.—Enlargement of Parish Hall in connection with St. Lawrence Church.

ISLE OF WIGHT.—New Prison in centre of Parkhurst Forest, for Board of Guardians.

KILNHURST (ROTHERHAM).—New Church Hall.

KENDAL.—Additions to 100, Highgate, for Mrs. Nowell; Stephen Shaw, architect, Kendal; alterations and additions to premises in Highgate, for J. Alexander & Sons and Atkinson & Griffin; J. Hutton, architect, Kendal.

KENNETHMONT (ABERDEENSHIRE).—Public Hall for the parish. Leith Hay, Leith Hall, promoter.

KINGUSSIE.—Hall in connection with the Kingussie Parish Church.

LEIGH-ON-SEA.—New Baptist Church. J. Bowhill, architect, Leigh and Stratford; F. J. Green, builder, Leigh.

LEONARD (WILTS.).—Additions to Grove House, Blunsdon Street. Drew and Sons, architects, 28, Regent Circus, Swindon.

LITTLE LEVER.—Rebuilding and repairing paper mills (after fire). W. Broadbent & Sons, Ltd.

LITTLEBOROUGH (LANCS.).—Additions to town house, for Gordon Harvey, M.P.; Institute at Ealees in connection with Littleborough Parish Church.

LONDON (DULWICH, S.E.).—New mission church in Lordship Lane.
(CHELSEA, S.W.).—New bank, King's Road, for London and County Banking Co., 21, Lombard Street, E.C.
(TOTTENHAM, N.).—United Methodist Church. Broad, Pettit & Co., builders, 247, West Green Road, Tottenham.
(DEVONSHIRE STREET, W.).—Buildings. J. Jarvis & Sons, builders, 253-255, Hackney Road, N.E.
(HOLLOWAY, N.).—Money Order Department of the G.P.O. to be transferred from Queen Victoria Street to Manor Gardens, Holloway, N.
(BRYANSTON SQUARE, W.).—Alterations to mansion. Whitby Bros., builders, Featherstone Buildings, Holborn, W.C.
(DOCKHEAD, S.E.).—Shops. Todd & Newman, builders, 1A, Stannard Road, Dalston, N.E.
(MARK LANE, E.C.).—Buildings in Byward Street. John Greenwood, Ltd., builders, 12-14, Arthur Street West, London Bridge, E.C.
(PORTLAND PLACE, W.).—Alterations to No. 65; E. Laurance and Sons, 14-16, Wharf Road, N. Alterations to No. 43; N. Liddstone, builder, 96, Blackstock Road, Finsbury, N.
(WELBECK STREET, W.).—Rebuilding No. 50, for J. Faulder, 58, New Cavendish Street, W.
(BLACKFRIARS, S.E.).—Repairs, &c. (£1,500), to Christ Church. Rev. E. J. Baker, rector.
(UXBRIDGE, N.W.).—New post office (£4,000); Geo. Jaggard, builder, New Bushey, Watford. Offices, Front Lane factory; Thomas and Thomas, surveyors, 191, Edgware Road.
(BATTERSEA, S.W.).—Extensions and improvements to Battersea Polytechnic (£5,000).
(WIMBLEDON, S.W.).—Shops and flats, High Street, and house Clifton Road; Thomson & Pomeroy, architects, 49, Hill Road, Wimbledon. Eight houses, Stewart Road, for C. Barwell, The Elms, Morden; residence and motor house, Caloune Road, Boyton, Sons & Trevor, surveyors, Wimbledon Park Station; house, Alan Road, for W. Allan Tanner, engineer, 16, Belvedere Gardens, Wimbledon; factory, Ashcombe Road, for L. S. Rogers, estate agent, 86, Lancaster Road, West Norwood; residence, Murray Road; Niven & Wigglesworth, architects, 104, High Holborn, W.C. Six houses, Richmond Road, Daw, Saville & Co., surveyors, 27, Chancery Lane, W.C.; additions to Queen's Road Schools, surveyor to the Education Committee, Town Hall, Wimbledon, S.W.
(HACKNEY, N.E.).—Electric light, power, bells and telephones to be installed; Pavilion "D," Hackney Infirmary, High Street, Homerton, N.E. F. R. Coles, Clerk to the Guardians, Sidney Road, Homerton, N.E.

LUTON.—New free library (£10,000). Gift of Mr. Carnegie.

MAGOR (MONMOUTHSHIRE).—New Wesleyan schoolroom at Undy (£350). A. Bartlett, builder, Magor; Scott & Block, architects, Newport.

MALTBY (near ROTHERHAM).—New colliery for Maltby Main Colliery Co., Ltd.; Maurice Deacon, managing director.

MANCHESTER.—Public baths at Harpurhey for the Corporation; new branch library for the Cheetham and Crumpsall District; Manchester Corporation Free Libraries Committee. New Congregational Church ("Zion" Church) and institute, Stretford Road; big sewerage scheme (£60,000); proposed extension, Cheetham Hospital; Alan F. Maclure, 36, Brazennose Street, Manchester. Extension of premises (proposed) Isaac Thorpe & Sons, Ltd., Church Street, Manchester; new manse, Hollingworth.
(LIGHTBOURNE).—New church of St. Luke's.
(LEVENSHULME).—New Wesleyan Methodist Church and schools (£1,300), East Road, for the Longsight Circuit.

MELKSHAM (WILTS.).—New Baptist Sunday Schools in connection with Broughton Road Church.

MELTON MOWBRAY.—Sewage disposal works for the U.D.C. (£19,987). E. Clarke, contractor, Melton Mowbray.

MIDDLE HULTON (near BOLTON).—Additional railways from Middle Hulton to Bolton for Lord Ellesmere.

MIDDLEWICH.—New Wesleyan Church and Sunday School (£5,400).

MIDSOMER NORTON (BATH).—Higher elementary school for Somerset C.C.

MILTON REGIS (KENT).—Additional accommodation for 260 scholars at Upton Lane School for Kent Education Committee. W. H. Robinson, architect, Caxton House, Westminster, London.

MIRFIELD (YORKS).—Billiard room at Hopton Grange for W. H. Marriott.

NEWARK.—Additions to Isolation Hospital, Bamby Road, for the Corporation. G. Sheppard, borough surveyor, Town Hall.

NEWBRIDGE (MON.).—Thirteen villas for the North Road Building Club, Newbridge. A. J. Bowen, architect, Crown Street, Crumlin.

NEWCASTLE-UNDER-LYME.—Four houses and shops, Chapwell, for F. Rupp. D. M. Spence, architect, Shatley Bridge. New Sunday School, Ashley Wesleyan Mission, Mortimore Street (£800). J. Jones, builder, Silverdale; R. T. Longden, architect, Burslem.

NUNEATON.—Smith's Bank premises to be set back.

LIVERPOOL.—Row of houses in Mayville Road. L. Marr & Son, builders and contractors.

LLANDRINDOD WELLS.—Improvements to the Spa and baths.

LLANELLY.—Proposed extensive additions to the Old Castle Iron and Tinplate Co.'s Works.

LLANFYLLIN (MONTGOMERYSHIRE).—Proposed alterations to the Town Hall.

OAKHAM.—Burley Hall to be re-built after fire. Right Hon. G. H. Finch, M.P., owner.

OBAN.—New manse for Argyll Square United Free Church (£730).

OSSETT.—New Conservative Club premises (£50).

OSWALDTWISTLE.—Sewage works and waterworks (£14,000). District Council.

OUTWOOD (YORKS.).—New United Methodist Church (£1,200).

OXFORD.—Extension of premises. Local Co-operative Society.

PAPA WESTRAY (KIRKWALL).—New house for medical officer. W. P. Drever, Kirkwall.

PENDLETON AND PENDLEBURY.—Colliery developments, &c., for Andrew Knowles & Sons, Ltd.

PENTREMAWR (CARMARTHENSHIRE).—Important colliery developments in the Cathan Valley by a new syndicate, with a capital of from £250,000 to £500,000.

PENZANCE.—Alterations and additions to the premises of *The Cornishman*; H. Maddern, architect, 13, Clarence Street, Penzance. Alterations and rebuilding of St. Peter's Parish Hall and Sunday School, Newlyn.

PERSHORE (near WORCESTER).—Proposed additions to Pershore Cottage Hospital. Write, Secretary.

PERTHSHIRE.—Extensive improvements at West Mains, of Ballechin, for Mr. Scott, Eastertyre, Aberfeldy.

PITLOCHRY.—New hall in connection with the United Free Church (£600).

PONTYPRIDD.—New offices for the B.G. Phillips & Vaughan, architects, Mon.

POOLE.—New Temperance Hall. Mrs. Squibb.

PORTH.—Two shops for J. Preece, ironmonger, Hannah Street. W. D. Thomas, architect, Porth, Glamorgan.

PORTSMOUTH.—Lock-up shop, Hyde Park Road, for W. R. Burridge, Meadow Street, Portsmouth; house and shop, Manor Park Avenue, for Seadden & Sons, George Street, Landport; house, Milton Road, for J. Durrant; house, Lomeragh Road, for J. J. Rogers; four houses, Chichester Road, for A. Crase.

ROCHDALE.—Five houses in Harvey Street. Edmund Whitworth, Hamor Hall Cottage, Rochdale.

New billiard hall, Nelson Street. Secretary, Billiard Halls, Ltd., Pendleton.

ROCHFORD (ESSEX).—Alterations at the Workhouse. F. Gregson, Clerk to the Guardians, 46, Alexandra Street, Southend.

ROTHESAY.—New U.F. Church.

SEATON DELAVAL (DURHAM).—Reopening and development of coal mines; Seaton Delaval Coal Co.

SEDGEFIELD (near FERRY HILL).—Nine houses, Dean Bank, for the Auckland Co-operative Society; 19 houses, Trimdon Grange, for Orton & Wanless; hall at Dean Bank, for the Dean Bank and Ferry Hill Social Institute.

SETTLE.—Billiard room at Abbeylands, Stackhouse, for R. Marshall; eight houses, Batty Croft, for W. J. Edmondson.

SHEERNESS.—New masonic hall, corner of High Street and St. George's Road. Architect, 21, Balmoral Road, Gillingham, Kent.

SHEFFIELD.—New parish room and Sunday schools at Norton Lees (£3,000); school buildings, Townhead Street, for the Board of Education; new Primitive Methodist Church (to seat 400), and school (four class rooms) (£1,200) at Chapeltown.

SLEIGHTS (near WHITBY).—New institute and village hall.

SLIGO.—New offices for the Hibernian Bank, Ltd. W. H. Byrne & Son, architects, 20, Suffolk Street, Dublin.

SOLIHULL (BIRMINGHAM).—House, Streetbrook Road, for Mr. Blackham; three houses, Barston Road, for Mr. Bell; one house, Birmingham Road, for Mr. Kearn.

SOUTHAMPTON.—Six cottages. H. M. Camfield, auctioneer, Woolston, Southampton.

SOUTHPORT.—New Council school, Sefton Street, Southport (£1,124). Town Clerk.

SOUTHWICK (SUSSEX).—New police station. County Surveyor, 22, Worthing Road, Horsham.

STOKE-ON-TRENT.—New Wesleyan Methodist Church, Stockton Brook. New buildings in connection with the Cottage Homes at Penkhull; A. R. P. Piercy, architect to the Guardians.

STONE (STAFFS.).—Alterations and additions to St. Mary's Hospital, for St. Dominico Convent.

SUNDERLAND.—Forty-eight workmen's dwellings at Tunstall, for the R.D.C. (£10,500). Joseph Spain, architect, 12, John Street, Sunderland.

SWANSEA.—Ten houses at Armena Road, Forestfach, and ten cottages at Cross Hands. C. S. Thomas, architect, 15, Wind Street, Swansea.

TAUNTON.—Two cottages at Bicknoller, for C. H. Greswell. Andrew and Hosegood, architects, Williton.

THORNTON (near FLEETWOOD).—Semi-detached houses, Thornton Gate, for J. Parker; two houses, Stockdove Way, Clevely, for Mr. Heyes; additions to houses, for J. Jenkins, E. A. Gadd and J. Hague.

THORNTON-LE-DALE (YORKS.).—New Wesleyan Church (£2,400). A. E. Lambert, architect, Park Row, Nottingham; A. Barnes, builder, Malton.

TIRPHIL (near CARDIFF).—Fifty-two houses, for the Birchgrove Building Club, New Tredegar.

TODMORDEN.—New Baptist Church, Charlestown Hill.

TURRIFF.—New municipal buildings, High Street; James Robb, builder, Turriff. Caretaker's house in connection with above in School Lane. Joseph Rae & Son, builders.

TROWBRIDGE.—Houses, Waterworks Road. J. Crook, builder, Bradford Road, Trowbridge.

UPTON (WORCESTERSHIRE).—Important sewage and waterworks schemes. Surveyor, Upton District Council.

WAKEFIELD.—St. Mary's "Parochial Buildings" to be built at Horbury Junction (£1,500). O. W. Richardson & Sons, architects; Hy. Fallas & Sons, builders, Horbury.

WARRINGTON.—Extensions to the technical schools for the T.C.; Thos. Longdin, borough engineer.

WHITLEY.—Proposed promenade pier for Whitley Bay Pier Co., Ltd. White and Stephenson, architects, Grey Street, Newcastle.

WIDNES.—New Salvation Army Hall, Widnes Road.

WIGAN.—Four houses, Northumberland Street, Goose Green, A. Sharples; additions to St. John's Hall, Dicconson Street, Rev. G. L. Carolan; additions to St. Catharine's Vicarage, Rev. C. Coulter; additions to Tippings Arms, at Worsley Mesnes, near Wigan, G. Airey; two houses in Barnsley Street, J. Whittier.

WINDSOR.—New Vicarage for All Souls' Church, South Ascot; house, Sunninghill, for Mr. Bellworthy.

WOLVERHAMPTON.—New Safe Works, electrically equipped, for Chubb and Sons, Ltd. Henry Lovatt, Ltd., builders, Darlington Street, Wolverhampton. Large works, Stafford Street, for concern acting in co-operation with W. Robinson, Ltd., Stafford Street, Wolverhampton.

WOODHALL SPA (LINCOLN).—House, Tor o' Moor Road, for W. H. Newbury.

WORCESTER.—Additions to premises. Local Co-operative Society.

WORSLEY.—Extensions and alterations at All Saints' School. Local Education Committee.

WORTHING.—Re-building the Volunteer Inn, Market Street; Denman and Matthews, Brighton, architects. Vestry in connection with St. Andrew's Church, Victoria Road, Rev. G. K. Boyd, vicar; Young & Hall, architects. House, Portland Road, for C. Bryant; house on east side of Westbrooke, for A. E. Poland, submitted by Patching & Co., Worthing; three houses, Lanfranc Road, for C. Stafford, submitted by J. E. Lund, architect, Worthing.

WREXHAM.—Public Hall to be rebuilt, with shops and arcade; Thos. Price, architect, Liverpool.

YARDLEY.—New secondary school (£17,571). W. Harvey Gibbs, builder, King's Heath. Extension of Isolation Hospital, Lynden End, for the District Council.

YNYSYBWL (GLAM.).—Twelve or more houses in Church Street. W. D. Morgan, architect, Pentre Rhondda.

YORK.—Semi-detached villas at Osbaldwick, for E. D. Smallwood, The Grange. E. T. Felgate, architect, York; L. McLaren & Co., builders.

YSTRADMYNACH (near CARDIFF).—Four houses, for Coslett Beddoe; shops, for Jenkin Bros. and G. & D. Jones.

NOTES.

The Cycloidal Engine.—At one time there was a heavy and numerous crop of rotary engines. Most of these employed a sort of shutter, which moved out of the way to admit the passage of a rubbing piece on the rotary piece, or a shutter moved in and out of the rotor itself, which rotated inside an eccentrically placed external casing. Of late years the shutter has been pretty generally abandoned, and very much more ingenious ideas have come forward; all these have aimed to reduce the large amount of rubbing friction which appertained to most of the rotary engines. One of these was the Hult engine. This had a shutter piece in its inner rotor, but to reduce friction to a minimum, the case in which the rotor turned was itself free to rotate in outer roller bearings, and steam was admitted, and cut off, and exhausted, by a valve contained in the hollow trunnion. This engine ran very quietly, and was shown driving a dynamo, and it seemed very suitable for small powers and high speeds.

In another engine the passage of the projecting blade or shutter was got over by means of a second rotor of the same size as the main, &c. The second rotor had a slot along it, into which the shutter entered, and so got past the critical point where usually it would have to slide quickly in and out. The second roller thus became the abutment to the steam, which drove the rotor by means of the projecting shutter, and the arrangement of the slot enabled the shutter to be fixed fast to the rotor, thus saving the sliding difficulty.

We saw lately a novel rotary engine called the Cycloidal starting out on a six weeks' voyage to the Antipodes, in a 7,000-ton steamer in the capacity of fan engine. It consisted simply of a double-lobed wheel, rotating slightly eccentrically, with a treble-lobed internal wheel. The rates of rotation are thus as two to three, and this velocity ratio is kept by means of spur gearing in order to save any departure from the correct angularity of the two-lobed rotors. At three points on the interior lobing are packing pieces against which the two-lobed rotor makes contact, and these prevent steam leakage. There are also steam packing pieces at the ends of the rotors against the outer case. The rotation is effected by the combined action of the eccentricity and of the varying volume of the chambers of the three-lobe rotor, as these are occupied or left empty by the double-lobe rotor. As the voyage above-named occupies some 42 days, the opportunity is a good one to show up both virtues and faults in the new engine. It ran well and quietly, and gave promise of doing well. But only an actual run can show.

Educational Notes.—UNIVERSITY COLLEGE, BRISTOL.—An announcement concerning the Engineering Courses at this College for the new session appears in our advertisement pages to-day.

BATTERSEA POLYTECHNIC.—The evening classes in electrical engineering (head of department, Mr. A. W. Ashton, M.Sc.), commence on September 21st, as announced elsewhere in this issue.

EAST LONDON COLLEGE, Mile End Road, E.—The new session at this College commences on September 28th, and particulars of the

engineering, electrical engineering, mathematical and chemical classes may be obtained from the principal, Mr. J. L. S. Hatton, M.A.

Rail Corrugation.—In connection with Prof. Carus-Wilson's lecture on the above, at the recent meeting of the Tramways and Light Railways Association, a communication was received from Mr. A. J. Panton, who said it was not sufficient to state that check cutting flanges or the action of an axle and wheels moving at an angle to the rails produced corrugations. We wanted to know why the back of the flange was ground away on one wheel and the throat of the flange was cut to a knife edge on the outer wheel of the same axle, showing that the axle was askew to the track. Was it due to sand or faulty truck construction? Sand or grit did not retard one wheel more than another, and sand, grit and packed grooves did not prevail on overhead railways, which suffered from corrugation; further, corrugation did not exist on his tramway (which formed an extension of the Liverpool Overhead Railway) although sand was there in abundance. Corrugations also existed on underground railways, with highly-polished rails; he thought the presence of a check rail was necessary to successfully form corrugations.

Mr. Fred Bland referred to the presence of corrugations upon the tires of certain Swedish tramway wheels which corresponded exactly with the corrugations on the rails.

Mr. W. F. Ireland wrote that he did not agree that the flange could not come into contact with the check until considerable wear had taken place. Given the conditions of wheel or track to produce what is virtually a cone-shaped roller or pair of wheels, check cutting can be produced without wear having taken place, as, for instance, if tires of different diameters are fitted to a pair of wheels, that pair will travel sideways along the track and produce check cutting and slip simultaneously. On the L.C.C. subway tramways, where all the wheels were turned to exact diameters and the coneing was to gauge, the trucks built perfectly square, the cars suspended on swing bolsters and with centre bearing swivels well lubricated, corrugations appeared within a few days of running, certainly before any check wear was discernible. The track is on wood sleepers, and would more or less set itself to the wheel treads. It may be suggested that slip at each wheel tread would cause only minute waves, but possibly accumulation of bending stress takes place in the axles.

Institution and Lecture Notes.—IRON AND STEEL INSTITUTE.—The autumn meeting of this Institute will be held at Middlesbrough from September 28th to October 2nd. Among the papers that are announced in the programme of arrangements are the following:—

"The Scientific Control of Fuel Supply," by Prof. H. E. Armstrong.

"Gas-Producer Practice," by Prof. W. A. Bone.

"The Production of Finished Iron Sheets and Tubes in one Operation," by Mr. S. O. Cowper-Coles.

"Some Results of Experience with Electrically-Driven Rolling Mills," by Mr. C. Koettgen and Mr. C. A. Ablett.

"Electric Power Supply," by Mr. C. H. Merz.

"A Test for Ascertaining the Relative Wearing Properties of Steel Rails," by Mr. E. H. Saniter.

"A Workshop Microscope," by Mr. J. E. Stead.

A large number of visits to steel and iron works, and other works, including electric power supply stations, in the neighbourhood, have been arranged for.

MUNICIPAL TRAMWAYS ASSOCIATION.—This Association's annual conference takes place at Nottingham on September 23rd to 25th, with Mr. J. Aldworth, the Corporation tramway manager, as president, and with the Victoria Station Hotel as headquarters. The papers announced are:—

"Some Through-Running Problems and their Solutions," by Mr. H. E. Blain (West Ham).

"Treatment of Corporation Employés incapable of performing ordinary duty," by Alderman Linsley (Salford).

Paper by Mr. J. M. McElroy (Manchester).

"Ticket Check," by Mr. L. Mackinnon (Glasgow Tramways Department).

Electrical Smelting Furnace for Steel.—By an oversight we omitted to state that the article on this subject, which appeared on page 342 of our last issue, was based on one appearing in the *Zeitschrift für Dampfkessel und Maschinenbetrieb* for May 29th, 1908, and the illustrations were reproduced from that journal.

Shock Fatality.—The *Daily Mail* reports that while manipulating a switchboard of 300-volt pressure at Messrs. Dick, Kerr & Co.'s electrical works, Strand Road, Preston, on Wednesday, John Johnson, aged 45, a foreman in the testing department, received a shock; he fell down unconscious, and died within a few seconds. How he received the shock is a mystery, for he had been working the switch throughout the day, and everything appeared to be working well.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—The Malvern U.D.C. has agreed to advance the salary of MR. C. D. GREENHALGH, assistant electrical engineer, by £20 per annum.

MR. PAPWORTH, burgh electrical engineer, Stirling, has been presented by the members of the T.C. with a drawing-room clock on the occasion of his marriage.

MR. P. F. ALLAN has resigned his position as electrical engineer on the new works staff of Messrs. Yarrow & Co., Ltd., Scotstoun, Glasgow, in order to take up an appointment as sales engineer on the staff of the Clyde Valley Electric Power Co., Glasgow. On August 28th his late colleagues and the electrical workmen presented Mr. Allan with a handsome writing cabinet.

Tramway Officials.—The Halifax Tramways Committee has recommended the T.C. to increase the salary of MR. J. W. GALLOWAY, rolling stock superintendent, from £130 to £145 per annum.

General.—On July 31st, at Cape Town, the members of the Central Telegraph office staff held a concert, at which they bade farewell to MR. JAMES TASKER, their chief. The Postmaster-General presided, and presented Mr. Tasker with a silver tea and coffee service. In reply, Mr. Tasker said that when he took over the controllership more than 20 years ago there was a staff of 22, and this was subsequently increased to considerably over 200.

MR. W. J. HORNE, lecturer in Physics at the South African College, Cape Town, who was until recently acting as secretary to the local Section of the Institution of Electrical Engineers, and has frequently occupied the position of consulting electrical engineer for electric light installations in the Cape Town district, has been appointed to the Transvaal Education Department as Organiser of Technical Education.

Obituary.—M. HENRI BECQUEREL.—We referred briefly in our last issue to the death of M. Henri Becquerel at the age of 56, on August 25th. M. Becquerel was permanent secretary of the Academy of Sciences, and rendered his name immortal by the discovery of the invisible radiation from uranium and its compounds known as the Becquerel rays. This discovery, at first sight of no great importance, when followed by M. and Madame Curie, who were pupils of Becquerel's, led to the discovery of radium and other radioactive compounds. The mathematical genius of J. J. Thomson revealed the true explanation of these new phenomena, which illustrated and confirmed his own contemporaneous discovery that the cathode rays represented fragments of broken up atoms. Becquerel's discovery was the starting point of a new departure in physical science which has led to a great and unexpected addition to our knowledge of molecular physics. M. Becquerel was awarded the Nobel prize in 1903, and received honorary degrees from Oxford, Cambridge, Manchester, and Aberdeen Universities.

We regret to record the death, which took place on 26th ult. at his residence at Waterloo, of MR. G. G. BLACKWELL, founder of, and senior partner in, the firm of Geo. G. Blackwell, Sons & Co., Ltd., manganese merchants, The Albany, Liverpool. The offices, works, &c., were closed on Saturday last on account of the funeral.

The EARL OF ROSSE, whose death, at the age of 67 years, we regret to have to record this week, was the son of an astronomer of great eminence who became a President of the Royal Society, and he was himself a prominent student of, and contributor to, astronomical science. He had long been a familiar figure at the gatherings of the British Association, and was an F.R.S. and an ex-vice-president of the Royal Institution. Among recent matters which have come before electrical engineers, one that engaged the attention of the late Earl was the inquiry concerning the effect of the operation of the L.C.C. power station upon the astronomical observations at Greenwich. It may be interesting to add that the Hon. C. A. Parsons, F.R.S., of turbine fame, is younger brother of the late Earl.

There passed away suddenly on the night of August 27th, MR. J. W. SPENCER, the chairman, and for 20 years managing director, of Messrs. John Spencer & Sons, Ltd., of Newburn Steel Works. Among the other concerns with which he was actively associated as a director, were the Newcastle and District Electric Lighting Co., Ltd., and Walter Scott & Co. The deceased gentleman was walking out with his son on Alnmouth golf links, when he became ill; he recovered sufficiently to go to the house of his son, where he died immediately.

We deeply regret to announce the death of MR. FRANCIS J. LAMB, of Muswell Hill, which took place on Saturday, August 22nd, at the age of 47 years. The deceased gentleman had been suffering from an internal complaint for two or three years past, and this culminated in a more pronounced illness which necessitated an operation. This was performed successfully, and at two stages Mr. Lamb made remarkable recoveries, but each was followed by a serious relapse, and, unfortunately, from the second he never recovered. The funeral took place at Marylebone Cemetery, Finchley, on Wednesday last week, in the presence of a large company of friends. At the time of his death Mr. Lamb was one of the directors of the London Electric Wire Co., Ltd., with which he had been connected for many years.

NEW COMPANIES REGISTERED.

Macdonald, Syer & Co., Ltd. (99,300).—This company was registered on August 24th, with a capital of £1,000 in £1 shares, to carry on the business of consulting, civil, electrical, constructional, marine, hydraulic, agricultural, areoplane, cycle, motor, locomotive, gas, tool, mining, textile, sewage, railway, inventors, and general engineers, &c. The subscribers (with one share each) are:—L. I. Woodley; Glenwood, Holly Park, Crouch Hill, N., accountant; C. S. Syer, 2, Felix Avenue, Crouch End, N., engineer; J. W. Fletcher, Oakleigh, Epping, engineer; W. E. L. Syer, 21A, Old Change, E.C., merchant and warehouseman; S. W. Wilkins, 28, Southwold Mansions, Elgin Avenue, W., engineer; J. G. Addinell, 41, Snow Hill, E.C., engineer; G. H. Addenbrooke, 81, St. Thomas Road, South Hackney, N.E., clerk. Private company. The number of directors is not to be less than two or more than five; the first are C. S. Syer (managing director) and J. W. Fletcher; qualification, 10 shares; remuneration as fixed by the company or by agreement. Registered office, 41, Snow Hill, E.C.

Bat Meter Co., Ltd. (99,327).—This company was registered on August 27th, with a capital of £20,000 in £1 shares (12,000 preference), to carry on the business of manufacturers of and dealers in electric, gas and water meters, &c. The subscribers (with one share each) are:—P. Bertin, 23-5, Northdown Street, N., C.E.; E. L. Biggs, 12, Montpelier Road, Holloway, N., clerk; J. E. Denney, 3, Great St. Helens, E.C., chartered accountant. Private company: The first directors (to be not less than three or more than seven) are G. Heeley, 1, Waverley Place, St. John's Wood, N.W.; F. A. Brocq, 16, Boulevard de Vangirard, Paris; and P. Bertin; qualification, £100; remuneration, £50 each per annum. Registered office, 3, Eden Street, Hampstead Road, N.W.

Rosario and District Railway Syndicate, Ltd. (99,284).—This company was registered on August 21st, with a capital of £60,000 in £1 shares, with objects chiefly indicated by the title. The subscribers (with one share each) are:—J. H. Wilson, 84, Buckingham Road, Southgate Road, N., clerk: E. J. Lyon, 16, Hawthorn Road, Bexley Heath, clerk. Private company. The first directors are to number not more than four; the subscribers are to appoint the first; qualification, 250 shares; remuneration, £150 per annum for the chairman and £100 each for the others, with 3 per cent. of the profits available for distribution, divisible (chairman to receive one-eighth per cent. of the said profits in addition to his share of the said 3 per cent.). Registered by Goddard & Co., St. Michael's House, St. Michael's Alley, Cornhill, E.C.

Dynamo-Electric Car Transmission Syndicate, Ltd. (99,331).—This company was registered on August 27th, with a capital of £2,000 in £1 shares, to adopt an agreement between F. Plutte and A. P. Wright of the one part, and W. C. Clark of the other part, for the purchase of certain patents and applications, and to carry on the business indicated by the title. The subscribers (with one share each) are:—A. P. Wright, "Waratah," Brighton Road, Coulsdon, Surrey, engineer; A. F. H. Hotopf, Glenthorne, Mayow Road, Sydenham, S.E., merchant. Private company. The first directors are A. P. Wright and A. F. H. Hotopf; qualification, 100 shares; remuneration as fixed by the company. Registered by C. J. Rawlinson & Son, 47, New Broad Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—This company's annual return was filed on June 23rd, when 62,700 ordinary and 100 founders' shares had been taken up out of a nominal capital of £100,000 in 99,900 ordinary and 100 founders' shares of £1 each. £62,800 has been received. Mortgages and charges: £50,000.

County of Northampton Electric Power and Traction Co., Ltd. (65,747).—This company's annual return was filed on July 28th, when the entire capital of £25,000 in £10 shares had been taken up and paid for in full. Mortgages and charges: Nil.

Indian Electric Supply and Traction Co., Ltd. (84,233).—This company's annual return was filed on July 24th, when 1,007 shares had been taken up out of a nominal capital of £600,000 in £5 shares. £4 10s. per share has been called up, resulting in the receipt of £4,531 10s. Mortgages and charges: £125,000.

Sunbeam Lamp Co., Ltd. (25,498).—Particulars of £10,000 debentures, created by resolution of January 28th, 1904, have been filed pursuant to Sec. 10 (3) of the Companies' Act, 1907, the amount of the present issue being £1,200. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Carbone Arc Lamp Syndicate, Ltd. (80,279).—This company's annual return made up to December 3rd, 1907, was filed on July 18th, 1908. 7,607 ordinary, 190 "A" deferred, and 190 "B" deferred shares have been taken up out of a nominal capital of £9,880 in 9,500 ordinary, 190 "A" deferred and 190 "B" deferred shares of £1 each. £1 per share has been called up on 107 ordinary shares, resulting in the receipt of £107. £7,880 is considered as paid on 7,500 ordinary, 190 "A" deferred, and 190 "B" deferred. Mortgages and charges: Nil.

Adams-Randall Telephone Patents Co., Ltd. (London) (61,457).—A statement of the total amount outstanding on July 1st, in respect of mortgages and charges created prior to that date, and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Charge dated April 22nd, 1899, securing £8,200.

Amalgamated Radio-Telegraph Co., Ltd. (90,129).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date, and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Charges dated 1907 and 1908 securing £22,474.

Durham Collieries Electric Power Co., Ltd. (83,421).—An agreement dated August 15th, 1908, to secure £21 annual remuneration to trustees (supplemental to agreement of July 15th, securing £2,500 and interest), has been registered. Property charged: General assets.

Crompton & Co., Ltd. (27,200).—A statement of the total amount outstanding on July 1st in respect of mortgages and charges created prior to that date and not required to be registered under Sec. 14 of the Companies' Act, 1900, has been filed pursuant to Sec. 12 of the Companies' Act, 1907. Particulars: Mortgage dated January 25th, 1895, securing £100,000 first mortgage debentures.

THE BRITISH ASSOCIATION MEETING.

Presidential Address to the Engineering Section.

As we go to press, the British Association for the Advancement of Science is holding its annual meeting in Dublin.

The Engineering Section is under the presidency of Mr. Dugald Clerk, M.Inst.C.E., and in that capacity he yesterday (Thursday) morning opened the proceedings by an address which is practically a history of the development of the science of thermodynamics. Mr. Clerk pointed out that whereas, by the middle of last century, the steam engine had attained to a high degree of perfection, the science of thermodynamics did not yet exist; the world was in complete darkness as to the connection between steam motive-power and heat. It was seen that motive power of almost any magnitude could be obtained by the agency of heat; but how it was obtained and how much power was connected with a given quantity of heat was quite unknown. Newton, Cavendish, Davy, and other leading thinkers had long before expressed their opinion that heat was a mode of motion, but the material theory of heat was still held by many.

Carnot was the first to enunciate clearly a more advanced theory. In 1824 his pamphlet entitled "Reflections upon the Motive Power of Heat," was published. Carnot endeavoured to arrive at the connection between heat and motive-power by inventing an ideal series of operations, by means of which the greatest conceivable amount of mechanical power may be obtained from a given quantity of heat under given circumstances (the Carnot cycle). The four operations which constitute this ideal are:—

1. The working fluid is confined at highest temperature and pressure behind a piston, and heat is added to keep the temperature constant as it expands, moving the piston and doing work upon it.

2. The heat supply is cut off, and the fluid continues to expand till the temperature falls to the lowest point, and its volume expands to a maximum.

3. The piston returns, compressing the working fluid, but allowing the heat of compression to escape (reduction of volume).

4. The piston compresses the working fluid to such an extent that the temperature rises again to its highest point, and the working fluid exists at the end of this operation at the same volume, pressure and temperature as at the beginning.

This demonstration at once gives a standard of the limit of mechanical power which could possibly be obtained from a given amount of heat and a given temperature fall. In pursuance of his investigations Carnot, as his writings show, intended to experiment on any one working fluid within the desired temperature range, in order to determine the work area in its relation to heat quantity and temperature fall. His early death, in 1832, however, prevented this development.

The next worker in this direction was William Thomson. Like Carnot he accepted without considering as wholly proved the material theory of heat. In his paper on "An Absolute Thermometric Scale Founded on Carnot's Theory of the Motive Power of Heat" (1848) he defined equal temperature differences as differences between the temperatures of the source of heat and the refrigerator, when the proportion of work produced from a given quantity of heat is the same. Following this up with an investigation on which he read a paper in 1849 entitled "Carnot's Theory of the Motive Power of Heat," before the Royal Society of Edinburgh, Thomson came to the conclusion that "A most careful examination of the entire experimental basis of the theory of heat has become more and more urgent." Further, he says, "The extremely important discoveries recently made by Mr. Joule, of Manchester, seem to overturn the opinion that heat cannot be generated, but only produced from a source where it has previously existed."

Joule's work, which he described in a paper before the Oxford meeting of the British Association in 1847, "On the Mechanical Equivalent of Heat," described the result of experiments with paddles rotating in liquids, driven by falling weights. This paper was over the heads of the majority of his contemporaries, and only Thomson (Lord Kelvin) was able to appreciate it. Following up the lines of thought then suggested, he came to two important conclusions, enunciated in his paper before the Royal Society in Edinburgh in 1851, "On the Dynamical Theory of Heat." In this paper he enunciated the theory of an absolute zero of temperature, viz., 273° C., as well as definitely accepting the dynamical theory of heat. The investigation had now reached a very important stage, and it was established that, besides the heat converted into work, a certain portion of the heat must be passed from the hot to the cold body in order that the remainder might assume the form of mechanical energy. The idea of an absolute zero also occurred to Clausius. It was arrived at by the application of the Carnot cycle to the quantitative equivalent of heat formulated by Joule.

At the time these discoveries were made, or, rather, fully imparted to the world, creative minds were numerous in the engineering world. Brunel had already designed (1852) the *Great Eastern*, with engines of 11,000 H.P. Armstrong had invented the Armstrong gun. Stephenson was at the height of his fame. Siemens was busy on the regenerative furnace. In 1853 attention was turned to the hot-air engine, chiefly through the building of a ship having such a motor in America, by Captain Ericsson. Brunel and Faraday did not consider it likely to be successful. Siemens, while upholding the theory of regeneration (a device for successively reheating the working fluid), appears to have preserved an open mind on the subject. Some statistics given by him in a paper of 1853 are interesting. He gives the pounds of coal per horse-power-hour required for a Boulton & Watt condensing engine as 8, for a good Cornish engine as 2·38, and for a hot-air engine as 3·57. A perfect engine he considered would consume 0·60.

The author concludes by saying that the modern internal combustion engine is the successor to the air engine, so fully discussed by eminent engineers 55 years ago.

The custom of making the presidential and opening address generally historical has an obvious purpose; it is intended to lay before the meeting what has been done up to the time of its convocation in the hope that in its comment thereon, and account of investigations relating thereto, some further conclusions may be arrived at which may advance the scientific information on the subject a step further. In the address above summarised, Mr. Clerk has not only placed before the Association a concise account of the knowledge already collected on the important subject of the heat-engine, but has given stimulating examples of the work previously done by this very Association in the furthering of that branch of science. Although the master-minds which evolved the controlling ideas are, so far as we know, no longer in operation, the evolution of the internal combustion engine has set in operation a great number of experimental processes which cannot fail to result in further elucidating the many problems concerned with the conversion of heat into mechanical power. The enumeration of the discoveries made during the last half of the last century gives rise to the reflection that, however absolute a theory, such as that of the material constitution of heat, appears at the time, any decided variant which may be discovered is worthy of a close and patient investigation as likely to lead to an emendation of the original theory, or at any rate to some application almost equally valuable. Finality, of a kind, must be established as a basis upon which to work; but it must be recognised that what is apparently final may be merely relatively or comprehensively so, and should not be held as a rigid law by the application of which the value of new theories may be tested and accepted, or rejected, according as they conform or do not conform thereto. Science stands in the position of an acute observer watching the numerous experiments, which, in a broad sense, mechanical and commercial engineering are continually carrying out; and following up, by patient investigation, any new line of thought suggested by the results of these experiments.

CITY NOTES.

Dumbarton Burgh and County Tramways, Ltd.

From the report of the directors to the first ordinary general meeting of shareholders, it appears that the accounts show the profit for the period to be £3,870 16s. 8d., which it is recommended should be applied as follows:—In payment of dividend at the rate of 6 per cent. on the preference shares, payable on September 30th, and calculated on the amount of calls from the date of payment till the close of the accounts, £2,140 14s. 10d.; in carrying forward, subject to directors' fees, the balance of £1,730 1s. 10d. The Dumbarton Burgh Tramways, acquired by the company in terms of its statutory powers, were taken over on January 1st, 1908, and have since been operated by the company. The County Tramways have been constructed, and the first section from Dumbarton to Alexandria was opened on May 7th, 1908, while the through route from Dalmuir to Balloch was opened on June 25th, 1908. The branch line from Alexandria to Jamestown is complete, with the exception of a few yards, which have been left incomplete pending arrangements for increasing clearway under the railway bridge. The traffic receipts from the tramways are reckoned as satisfactory, the through line only having been in operation about five weeks prior to the closing of the accounts.

Lisbon Electric Tramways, Ltd.

A general meeting of the debenture-holders of the above company was held on Wednesday last, at the offices, 1, London Wall Buildings, Mr. L. Wagner presiding.

The Chairman said that the circular letter which accompanied the notice convening the meeting sufficiently explained the reasons why the directors requested the trustees to the debenture-holders to call them together. They were asked to pass a resolution relieving the company from the restriction hitherto imposed on it under the terms of the trust deed whereby it was not permitted to buy in the debentures of the company, and at any future time re-issue the same, should such a measure at any time be for the interest of the company generally. The resolution which they asked the debenture-holders to approve, removed that restriction, and was in the best interests alike of the debenture-holders and the shareholders of the company. He might add that if the resolution was carried, it would in no way interfere with the annual drawing for the redemption of debentures due to commence on July 1st, 1909. He concluded by moving the resolution as follows:—"That this meeting of debenture-holders of the Lisbon Electric Tramways, Ltd., secured by indenture dated November 22nd, 1899, hereby assents to the said company's proposal (assented to by such trustees) that the said indenture and the debentures issued under it shall henceforth be read and construed as if the words contained in the five concluding lines of Clause 34 of the said indenture and the same words at the conclusion of Condition 10 of the said debentures, and of the forms thereof set out in the first schedule to such indenture, were omitted, and that the rights of the debenture-holders and of the said company and the provisions of the said trust deed be modified accordingly, and that, for the purposes aforesaid, the trustees of the said indenture be, and they are hereby authorised, to concur with the company in executing a proper and sufficient supplemental trust deed in such terms as the said trustees may be advised."

In the explanatory circular referred to by the Chairman, it was pointed out that as things stood the company was, by Clause 10 of the trust deed and by Condition 9 in the debentures, bound to redeem the debentures by the operation of a sinking fund, and these provisions it was not proposed to alter. The deed also authorised the company to purchase or redeem in the market or otherwise debentures of the series, and prohibited the re-issue thereof. But for this prohibition, the company under Clause 15 of the Companies' Act, 1907, would be at liberty to keep alive and re-issue debentures so purchased or redeemed. It was desired that the prohibition should be removed, so that the company might be able to exercise the statutory power, for it was anticipated that in the carrying-on of the business the exercise of the power might from time to time be advantageous to the company, seeing that it would enable the company to invest temporarily in its own debentures without losing the power to re-issue if occasion required.

Mr. F. Eckstein seconded the resolution, which, on a show of hands, was carried.

A formal poll was taken, at which the Chairman announced that proxies in favour of the resolution representing £320,200 had been polled, and only one representing £600 against. As the amount required to carry the resolution was £250,000, he declared it carried with the requisite majority.

South Metropolitan Electric Light and Power Co., Ltd.—Warrants for interim dividend on the 7 per cent. cumulative preference shares for the half-year ended June 30th, 1908 (payable on the 31st ult.), have been posted.

MARKET QUOTATIONS.

Wednesday, September 2nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	38/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	45/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£21	..
a Lead, Nitrate	per ton	£27	£1 dec.
a ,, White Sugar	per ton	£24	£3 dec.
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	115/-	10/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b ,, Wire, in ton lots	per ton	£150	..
b ,, Sheet, in ton lots	per ton	£128	..
c Babbitt's metal ingots	per ton	£50 to £130	..
c Brass (rolled metal 3' to 12') basis	per lb.	8d.	1½d. inc.
c ,, Tube (brazed)	per lb.	8¾d.	¼d. dec.
c ,, ,, (solid drawn)	per lb.	7¾d.	¼d. dec.
c ,, Wire, basis	per lb.	6¾d.	..
c Copper Tubes (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	9¼d.	..
g Copper Bars (best selected)	per ton	£75	..
g Copper Sheet	per ton	£75	..
g ,, Rod	per ton	£74 to £76	..
c ,, (Electrolytic) Bars	per ton	£64	..
c ,, ,, Sheets	per ton	£80	..
c ,, ,, Rod	per ton	£69	..
c ,, ,, H.C. Wire	per lb.	8¼d.	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	4/- to 4/0½	inc.
i Iron Pig (Cleveland warrants)	per ton	51/- to 51/6	..
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£14	..
g Lead, English Ingot	per ton	£13 10	5/- dec.
m Manganin Wire No. 25	per lb.	8/-	..
g Mercury	per bot.	£8 2 6	5/- inc.
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/1½	..
p ,, rolled bars & rods	per lb.	1/2 to 1/3	..
p ,, ,, strip & sheet	per lb.	1/2½ to 1/6	..
o Platinum	per oz.	85/- to 90/-	..
e Silicium Bronze Wire	per lb.	9½d.	..
r Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	per ton	£131 2	£1 8 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/9	..
p White Anti-friction Metals— "White Ant" brand	per ton	£34 to £58	..
k Zinc, Sh'ts (Vieille Montagne bnd.)	per ton	£23	£1 5 dec.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Stock Exchange Notices.—Application has been made to the Committee to allow the following security to be quoted in the Official List:—

Mexican Light and Power Co.—Further issue of $900,000 7 per cent. cumulative preference stock in shares of $100 each.

The Committee has ordered the undermentioned security to be quoted in the Official List:—

Rio de Janeiro Tramway, Light and Power Co., Ltd.—$456,600 additional first mortgage 30-year 5 per cent. gold bonds, Nos. 59,001 to 65,285 and 75,225 to 77,000 for $100, and 29,490 to 29,600 for $500 each.

General Electric Company of Russia.—The correspondent of the *Financial Times* says that the above company has realised for the past year a net profit of 511,470 roubles, as against 439,050 roubles for the previous year. The board propose to distribute a dividend of 4 per cent., against 3 per cent. last year.

STOCKS AND SHARES.

Tuesday Evening.

Business in the Stock Exchange has broadened out very considerably within the last few days. Both investment and speculation have awakened in a manner somewhat remarkable, considering that the holiday season is hardly over, and that there is really no especial reason for revival at this particular juncture. It is this latter consideration which gives rise to some doubt amongst authorities as to whether the improvement will be sustained—reared, as it is, upon the slightly precarious basis of a boomlet in Kaffir shares.

The long-continued dullness of Consols and other gilt-edged securities is not affecting the steady demand for sound stocks amongst industrial companies. Half a score or so of rises amongst telegraph Debenture issues is evidence of the investor's hand, and the stocks are by no means easy to secure at the advanced quotations.

Heavy gambling in American rails has helped to lever up the price of Anglo-American Telegraph Deferred stock, which shows a rise of £1 1s., and has been yet higher. The 6 per cent. Preferred gained ½. American Telegraph and Telephone Capital stock gained two more points, and the buying has extended to the 4 per cent. bonds, the price being 1½ better at 91½. Commercial Cable Debenture put on 3, rising to 88½ upon a quite retail amount of stock changing hands.

Of the Ordinary stocks and shares, Eastern has gained 1, and the little West India and Panama are $\frac{1}{16}$ up, but Great Northerns lost their improvement of a week ago. No notice has been taken of the threatened new German cable.

National Telephone Preferred has slightly improved its position; the Preference shares are all better. The Deferred, however, shed a point. Other telephone descriptions have maintained all their recent strength.

Some of the Home Railway stocks are escaping from their fit of the doldrums, and even the Undergrounds come in for a little recognition. This is seen in the welcome, if small, advance in Central London Ordinary and Deferred stocks. Metropolitan Consolidated rose to 37, but eased off to 36, and a rise of 1, which lifted Districts to 12, was modified by a subsequent 10s. fall. The lamentable report just issued by the London General Omnibus Company ought to have done something to revive heart of grace in the Tube stocks.

It is still the Canadian group of tramway, power and lighting companies which engages by far the most considerable amount of interest and attention in electrical sections. The advance goes on gaily, punctuated by very occasional reactions, and the catalogue of prices has now reached a level of height which renders astonishing the prices of a few weeks ago. We take some of Monday's prices, with another list showing what they were on June 1st, only three months back. A third column gives the rise; dividends are not taken into account. Dealing with the lighting issues first, these are representative examples of the movement which has occurred:—

Stock.	June 1st.	Aug. 31st.	Rise.
Canadian General Co.	88	102	14
,, ,, ,, Preference	109	115	6
Electric Dev. of Ontario 5 per cent.	84½	87½	3
Mexican Electric 5 per cent.	80½	86½	6
Mexican Light and Power Co.	55	83½	28½
,, ,, ,, ,, 5 % Bonds	86½	90½	4½
Shawinigan Co.	72	82	10

In the tramway division the advance is much more marked, as the following list indicates:—

Stock.	June 1st.	Aug. 31st.	Rise.
Mexico Trams Co.	94	129	35
,, ,, 5 per cent. Bonds	89	95	6
Rio Trams 5 per cent. Bonds	85	90	5
Sao Paulo Trams	131½	161½	30
,, ,, 5 per cent. Debentures	96½	99½	3

Tuesday market found some of these prices inclined to slide. Mexican Light and Power lost 3 and the Tramway 1, but Canadian General rose 2.

Were it not for the activity in these securities, the dealers in electrical varieties would find little enough to do. This week's list of home stocks and shares is colourless in the extreme. London Electric Preference and South Metropolitan Preference are both quoted *ex* dividend, and Newcastle-on-Tyne Ordinary declined. Westminster Preference rose 2s. 6d. These are the only changes to be noted.

Several of the manufacturing shares have advanced, British Insulated, for instance, adding 5s. to the price of the Ordinary. Dick, Kerr's are harder, Castner-Kellners continue to improve, and Electric Constructions have stiffened. Callender's and Henley's Debenture stocks again moved up 10s. simultaneously. Henley's Ordinary show in their price the deduction of the 5s. dividend. Telegraph Constructions are 10s. to the good.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations August 25th.	Closing Quotations Sept. 1st.	Business done week ended Sept. 1st, 1908. Highest	Lowest.	Rise + or Fall −	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2 — 3	1⅜ — 2⅜	..	..	..	Nil.
143,800	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	Nil	5 %	5 %	5 %	89 — 92	90 — 93	..	..	+1	5 7 6
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7½%	7½%	8 %	8 %	126 —130	128 —132	..	..	+2	6 1 3
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	89 — 92	90⅜ — 92½	91¼	90⅜	+1	4 6 6
598,180	Anglo-American Telegraph	Stock	2⅜%	3½%	3⅜%	3¼%	58 — 61	58 — 61	60	..	..	5 14 9
3,200,910	Do. do. do. 6 % Pref.	Stock	5¾%	6 %	6 %	6 %	103½—104½	104 —105	104⅝	104¼	+ ½	5 14 3
3,200,910	Do. do. do. Deferred	Stock	Nil	⅛%	1⅜%	1 %	16 — 16⅝	17 — 17⅛	17⅛	16 5/16	+1	5 14 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8½	8 — 8¼	8¼	..	..	4 14 1
2,388,376	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	84 — 87	87 — 90	88¾	85¾	+3	4 8 11
16,000	Cuba Telegraph	10	5 %	5 %	5 %	6 %	7⅛ — 8⅛	7⅛ — 8⅛	7¼	..	..	7 1 2
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	15½ — 16½	15½ — 16½	..	..	..	6 1 3
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8 — 8¼	8 — 8¼	..	..	..	6 3 1
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	3 14 10
60,710£	Direct United States Cable	20	8½%	4½%	4½%	4½%	13⅛—13⅝	13⅛— 13⅝	13⅛	..	..	6 4 10
50,900£	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,900, R.	100	4½%	4½%	4½%	4½%	99 —101	100 —102	..	..	+1	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	135½—138½	137½	135½	+ ½	5 8 4
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	84 — 86	84½— 86½	86¼	85	+ ½	4 0 11
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	4 %	102 —104	102⅜—104⅜	104	102⅜	+ ⅜	3 16 7
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅜— 13½	13⅜— 13½	13 7/16	12 7/16	..	5 5 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100½—102½	100½—102½	101⅛	100	+ ⅛	3 18 1
269,700	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99½—101½	..	..	+ ⅜	3 18 10
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	102⅜ — ..	102⅜	..	+ ⅜	3 17 8
181,127	Globe Telegraph and Trust	10	5⅝%	5⅝%	5⅝%	5⅝%	10⅜ — 11	10⅜ — 11	10 3/16	10⅝	..	5 14 10
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜ — 14	13⅜ — 14	13⅜	13 9/16	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen	10	24 %	24%	20 %	20 %	28 — 30	27½ — 29½	..	..	..	6 13 4
19,600£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	100 —102	..	..	+1	4 8 3
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	56 — 59	56 — 59	..	..	..	6 7 1
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	69 — 73	69 — 73	..	..	..	5 9 7
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	69 — 73	69 — 73	..	..	..	5 9 7
384,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜ — ½	⅜ — ½	10/-	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 6 8
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	31/32—1 1/32	31/32—1 1/32	..	..	..	5 8 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107½ -109½	108 —110	109½	108½	+ ½	5 9 1
3,725,000	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	119½—121½	118½—120½	121	120	—1	4 19 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10½— 11½	..	..	..	5 4 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10 — 12	10½— 11½	..	..	..	4 6 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16— 5 1/8	5⅛ — 5⅜	..	..	+ 1/16	4 6 11
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	98½—100½	98½—100½	99⅜	..	..	3 7 8
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	103 —105	103 —105	103⅝	103½	..	3 16 2
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¾%	7 %	7 %	8 %	1 3/32— 1 1/32	1 3/32— 1 1/32	..	..	..	5 19 8
50,000	Do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	25/7½	..	..	4 11 5
99,100	Do. do. do. 4 % Red. Deb. Stock	100	..	4 %	4 %	4 %	89 — 92	88 — 92	..	..	..	4 7 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —101	99 —102	..	..	+1	3 18 5
11,889£	Reuter's	8	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7 — 8	7⅛	..	— ⅛	5 0 0
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
3,088	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	128 —131	128 —131	100½	..	..	4 11 7
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	5 12 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4½ — 4⅝	4½ — 4⅝	..	..	..	5 5 3
80,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	2⅜%	2⅜%	1 3/16— 1 1/8	1 3/16— 1 1/8	..	..	..	4 8 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	98½—101½	99 —102	..	..	+ ½	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	7 %	13⅜— 14½	13⅜— 14½	14 1/16	13⅜	..	4 19 3
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101½—103½	..	..	+ ½	3 17 4
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1/16— 1/8	⅛ — ¼	11/10½	..	— 1/16	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	6 %	8 — 8½	8 — 8½	8½	8	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	£2 6	8½ — 9½	8½ — 9½	..	..	..	2 9 0
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	100½—102½	101 —103	..	..	+ ½	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

320,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	9 %	8⅝— 8⅞	8 1/16— 8 15/16	8 13/16	8 11/16	+ 1/16	5 0 8
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5⅓%	5⅓%	5⅓%	5⅔%	6 3/16— 6 7/16	6 3/16— 6 7/16	6⅜	6 3/32	..	4 9 4
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	141 —146	141 —146	..	..	..	4 2 2
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
330,000	Babcock & Wilcox, 1 to 330,000	1	20 %	20 %	20 %	20 %	3⅞ — 4⅛	3 13/16— 4 1/16	80/-	77/6	— 1/16	4 18 9
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	3 13 10
40,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2⅝ — 3⅛	2⅝ — 3⅛	59/6	..	..	10 15 4
40,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	3⅞ — 4⅛	3⅞ — 4⅛	75/-	..	..	8 4 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	6 6 4
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	4 14 1
238,200	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	106 —110	106 —110	..	..	..	4 10 11
800,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	8 %	128 —128	129 —133	..	..	+5½	6 0 4
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	109 —113	109 —113	111½	..	..	4 8 6
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —108	104 —108	..	..	..	4 12 7
233,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —104	101 —104	104½	103½	..	4 6 7
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
138,301	British Electric Traction	10	6 %	3 %	Nil	Nil	1¼ — 1½	1¼ — 1½	26/3	25/7½	..	Nil
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	8 %	3¼ — 4⅛	3¼ — 4⅛	33/6	31/3	..	7 1 2
1,473,653	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	95 — 98	96 — 99	97½	..	+1	5 1 0
528,336	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	76 — 78	76 — 78	77	..	..	5 15 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	10 %	6¼ — 6⅜	6¼ — 7	..	..	+ ⅛	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6¼	6 — 6¼	..	..	..	4 12 4
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	93 — 98	91 — 96 xd	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	8/-	7/6	— 1/16	Nil
1,016,853	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	43 — 48	43 — 48	45	..	..	8 6 8
50,000	‡ Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	2½%	Nil	Nil	0— ⅛	0 — ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	70 — 75	68 — 73	..	..	—2	6 3 3
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	50 — 54	50 — 54	..	..	..	8 6
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	5¾ — 6	5¾ — 6	..	..	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 30,000	5	..	5 %	5 %	5 %	4⅝ — 5¼	4⅝ — 5¼	..	..	..	4 15 3
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
35,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	15 %	9⅜ — 10⅜	9⅜ — 10⅜	..	..	..	6 19 6
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	5 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106⅜—108½	107 —109	..	..	+ ⅛	4 2 7
491,222	Cape E Trams., 1 to 491,222	1	5 %	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	12 %	1⅛ — 1⅜	1 3/16— 1 5/16	32/9	30/-	+ 1/16	7 14 10
215,045	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	102 —105	103 —107	104	..	+1	4 4 1
1,898,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	8 %	67 — 69	68 — 70	69½	68½	..	4 6 11
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	49 — 52	50 — 53	51	..	+1	3 15 6
1,480,000	City and South London Railway	Stock	2¼%	1½%	2¾%	2¼%	32 — 33	32 — 33	33¼	32	..	6 8 9

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Aug. 25th.	Closing Quotations Sept. 1st.	Business done week ended Sept. 1st, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	S	2½%	2½%	5 %	5 %	1 5/16 — 1 9/16	1 5/16 — 1 9/16	..	..	..	9 10 6
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 5 11
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1 3/16 — 1 5/16	1 9/16 — 1 7/16	..	..	+ 1/16	6 19 2
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1 1/16	A — 1 1/16	23/-	..	..	4 16 0
282,580	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6%	12 — 13	11¾ — 12½	..	..	— 1/16	5 4 0
59,997	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	2½%	4½%	4½%	4½%	2/16 — 3/16	2/16 — 3/16	11/-	..	..	16 12 6
17,139	Do. "A" shares, 01—017,139	5	2½%	4½%	4½%	4½%	1½ — 2¼	1½ — 2¼	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	76 — 79	76 — 79	..	..	..	5 1 3
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	85 — 87	85 — 87	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 2/16	3/16 — 4/16	..	..	+ 1/16	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1 1/16 — 1 3/16	1 1/16 — 1 3/16	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7½ — 8	7½ — 8	..	..	..	6 5 0
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	86 — 90	86 — 90	..	..	..	4 8 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	4 %	¾ — 1	¾ — 1	16/3	..	..	5 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10¾	10¼ — 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15%	10¾ — 11¼	10¾ — 11¼ xd	..	..	..	8 18 10
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5½	5 — 5½	..	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106½ — 108½	107 — 109	108	107½	+ ½	4 2 7
60,000	India-Rubber, Gutta-percha & Telegraph Works.	10	5 %	10%	10 %	10 %	15¾ — 16¾	15¾ — 16¾	15⅝	..	..	6 1 8
87,500	†Liverpool Overhead Railway, Ord.	10	13%	Nil	Nil	¼	1 5/16 — 1 7/16	1¼ — 1½	..	..	— 1/16	4 0 0
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5½ — 6	5½ — 6	..	..	..	8 6 8
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	8 %	8 %	8 %	6½ — 6⅝	6½ — 6⅝	..	..	..	4 8 11
399,930	Do. do. 50,008 to 100,000	10	6 %	8 %	8 %	8 %	6½ — 6⅝	6½ — 6⅝	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	5½ — 6⅛	6 1/16 — 6	..	..	..	7 18 10
1,881,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 81	76 — 81	79¼	76	..	4 18 9
5,782,062	Metropolitan Consolidated	100	3 %	2⅝%	1 %	⅛%	35 — 36	35 — 36	38	35½	..	1 7 5
2,640,914	Do. Surplus Lands	100	2⅝%	2⅝%	2⅝%	2⅝%	65 — 67	65 — 67	67	66	..	4 2 1
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	10¾ — 11¼	11 — 12	12⅛	11	..	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/32 — 3/32	1/32 — 3/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	7/32 — 9/32	7/32 — 9/32	..	..	..	6 3 1
350,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	93 — 96	92 — 95	94½	..	—1	4 14 9
245,500	Potteries E. Trc.	1	5 %	4 %	4 %	4 %	1/32 — 3/32	1/32 — 3/32	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/32 — 3/32	1/32 — 3/32	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	31½ — 33½	32 — 34	33	..	+ ½	5 14 9
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —102	100½—102½	..	..	+ ½	3 18 1
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	5 %	39 — 43	38 — 42	..	..	—1	11 18 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	3/32 — 1½	3/32 — 1½	..	..	..	8 0 0
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	2½ — 3	2½ — 3	..	..	..	10 0 0
46,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 76	72 — 76	..	..	..	5 5 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	5½%	4½ — 5	4½ — 5	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
30,131	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	10 %	6⅝ — 7⅜	6⅝ — 7⅜	..	..	..	6 9 0
9,869	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6¾ — 7¼	6¾ — 7¼	..	..	..	4 13 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 — 102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3¾ — 4	3¾ — 4	..	..	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4	3¾ — 4	..	..	..	5 12 6
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	94½ — 96½	95⅝	..	—2	4 2 11
49,496	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	4½%	3 — 3½	3 — 3½	..	..	..	6 8 7
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9⅜ — 10⅛	9⅜ — 10⅛	9⅝	9⅜	..	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11¼ — 12¼	11¼ — 12¼	12 1/16	..	..	4 14 1
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 0 0
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
40,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	2 %	2¼ — 3	2¼ — 3	..	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3¾ — 4¼	3¾ — 4¼	..	..	..	5 17 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7½ — 8½	7½ — 8½	8½	7 1/16	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10¾ — 10¾	10¾ — 10¾	10¾	..	..	5 10 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	Nil	1/32 — 3/32	1/32 — 3/32	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	Nil	¾ — 1	¾ — 1	..	..	..	Nil
488,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 66	59 — 66	..	..	..	6 16 4
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5½	4⅜ — 5½	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 — 100	97 —100	..	..	..	4 10 11
15,000	Hove, 1 to 15,000	5	8½%	9 %	9 %	8½%	6 — 6½	6 — 6½	..	..	..	6 10 9
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	10 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	94	..	..	4 2 6
10,000	London Electric Supply Corporation, Limited, Ord.	3	8 %	4 %	4 %	2½%	1 — 1⅛	1 — 1⅛	..	..	..	5 8 1
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	4½ — 5	4⅜ — 4⅝	87/6	..	— 1/16	6 3 1
74,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 92	89 — 92	..	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6½%	4½ — 5	4½ — 5	..	..	..	6 3 11
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	4 12 4
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	..	..	..	4 2 7
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	84 — 89	84 — 89	..	..	..	3 18 8
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	5 — 5⅛	5 — 5⅛	..	..	— 1/16	7 5 5
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 6 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11⅝ — 12⅜	11⅝ — 12⅜	..	..	..	5 17 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	5 14 3
80,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 99	..	..	..	4 0 10
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7 — 8	7 — 8	..	..	..	6 5 0
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6½ — 7½	6½ — 7½	..	..	..	4 16 7
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	86 — 90	86 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	1/32 — 3/32	1/32 — 3/32	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 11 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2⅜ — 2⅞	2⅜ — 2⅞	..	..	..	6 19 2
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	1/32 — 3/32	1/32 — 3/32	..	..	..	4 0 0
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1⅛	1 1/16 — 1 3/16 xd	..	..	..	5 12 0
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾ — 1	¾ — 1	..	..	..	20 0 0
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	10 10 6
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	82 — 86	82 — 86	..	..	..	5 5 11
110,000	Westminster Electric Supply, Ord.	5	14 %	12 %	12 %	10 %	7⅜ — 8⅛	7⅜ — 8⅛	8	..	..	5 17 8
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %,—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	5 — 5⅛	5⅛ — 5⅜	5 5/16	..	+ 1/16	4 0 0

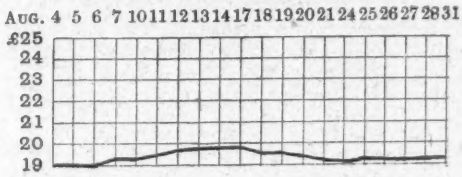
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 2½ per cent. May 28th, 1908.

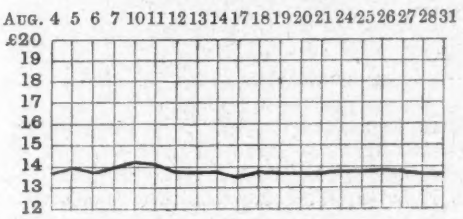
METAL MARKET.

Fluctuations in August.

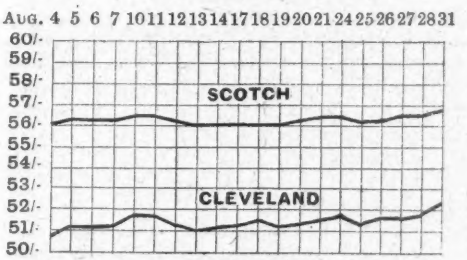
SPELTER (G.O.B's.).



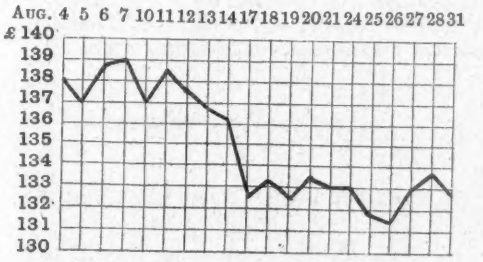
LEAD (ENGLISH).



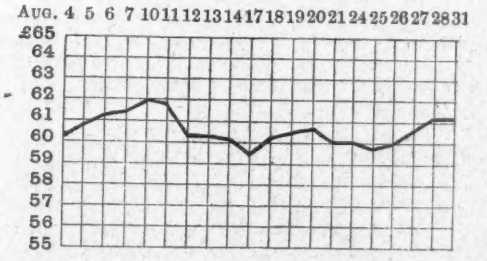
IRON.



TIN.



COPPER (G.M.B's.).



Anglo-Spanish Electrical Trade.—More Aggressive Tactics Urged.—H.M. Consul at Bilbao, Mr. A. Maclean, observes that in the North of Spain buyers are so accustomed to deal with German and Swiss firms only in the electrical machinery trade that it is difficult to make them believe that similar goods are manufactured in the United Kingdom, and the only practical way for British firms to secure any share of this trade is to combine to open branches in Spain, carrying representative stocks and with a staff of technical experts who can speak Spanish. In Mr. Maclean's opinion the electrical machinery and motor trades in Spain possess considerable potentialities, but British industry must adopt aggressive tactics to derive advantage from them.—*Board of Trade Journal.*

ARTIFICIAL LOAD FOR TESTING ELECTRICAL GENERATORS.

By NORMAN YOUNG.

An abstract of a paper read before the Birmingham Section of the Institution of Electrical Engineers appeared in the Electrical Review of March 13th. The forms of tanks, system of regulation, and general working therein put forward are so exactly opposite to what is usual practice with us, that I think it worth while to make the following remarks, principally to show how much cheaper and how much more efficient it is to work with low conductivity water. The results achieved at Birmingham were obtained chiefly because of the high conductivity of the water used. To get a large resistance with this high-conductivity

Fig. 1.

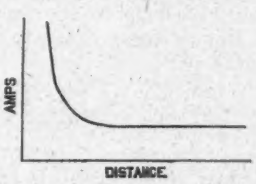


Fig. 2.

solution, it was evidently necessary, first, to work with the plates at a considerable distance apart; secondly, to use a narrow tank, very little broader than the plates; and thirdly, to keep the water temperature low. If a high-resistance solution had been used, the plates could have been kept very close together—in fact, just close enough to allow of a free water circulation between them. They could then have been adjusted by hoisting them out of, and into, the solution, which method is really the best to adopt in regulating load on a water resistance. The solution could also have been worked up to boiling point, and so, having a constant temperature, there would not be the continual fluctuation of the load that is got when working at any lower and unsettled temperature. The greatest advantage got by working at boiling point is that the great dissipation of heat caused by latent heat can be taken advantage of, and a great saving in water thus effected. Alternators of voltages up to 10,000 could be tested in a single tank with no more than 2 ft. between the electrodes, which, of course, should be of suitably small proportions.

The theory of the electric water resistance does not seem to be well known. I beg to tender the following explanation, which will make plain why no regulation was got at Birmingham by varying the plate area when the distance apart of the plates was great.

Take any two plates close together in a tank, which is large and roomy; it will be found that the current, with a constant voltage, varies proportionally to contact

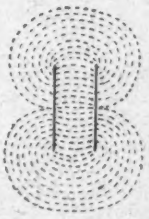


Fig. 3.

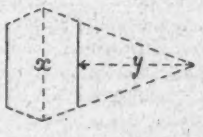


Fig. 4.

surface until a point is reached where the depth of the plate in the solution equals half of its breadth, when the curve rounds off more steeply as in fig. 1.

It will also be found that the current varies approximately as the square of the distance apart of the plates. The curve got is shown in fig. 2.

Fig. 3 illustrates the path taken by the current through the solution, and it is the interception of these lines of path that makes all the difference with the long narrow tank.

I will now endeavour to explain why the current varies almost as the square of the distance apart of the plates. In fig. 4 let y be a constant, which is found to be approximately constant for any given size of plates. Project lines from a point y distance behind the centre of a 4-in. plate, and let them touch the edges of the plate and be produced to meet similar lines from behind the other plate. Join the points of intersection, and it will be found that the area of the figure formed in plan by x, when divided by the distance apart of the plates, gives the actual effective conducting area of the solution. As the distance apart of the plates increases, of course x increases, and it will be found that, once the 4-in. plates have been taken 12 in. apart, area x divided by the distance decreases very little. This explains why, when the plates are close together and the area is varied, the curve got is not regular, for it is perfectly obvious that after a point is reached where the depth of plate in the solution is equal to half its breadth, the fringe at the bottom of the plate begins more and more rapidly to disappear along with the decrease of plate area.

Now, let us apply this to a long narrow tank, with plates nearly equal to the breadth of the containing vessel.

In fig. 5 we see that the converging lines are nearly all intercepted when the plates are full in. Draw the plates up out of the solution, and we find that even when the plates have been raised considerably the fringe still intercepts the bottom of the tank. Until a point is reached when the plates have been drawn out far enough to cause the converging lines to flatten, and so keep clear of the bottom of the tank, no appreciable reduction in current will be noticeable.

Let me now show what I consider the best arrangement of plates, and give a few actual results obtained from this arrangement.

In fig. 6 three plates are arranged delta-wise. In practice they are bolted on to a rigid wood frame, and exactly spaced. They are of precisely similar dimensions, about 2 ft. 6 in. × 3 ft. 6 in., and are suspended and balanced by means of

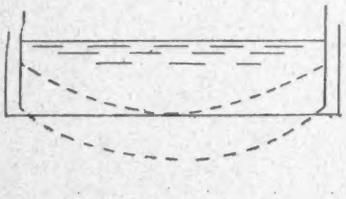


Fig. 5.

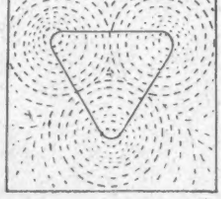


Fig. 6.

ropes run on insulator pulleys with weights attached. In use on a three-phase alternating set, the plates can be canted, by lowering or raising one corner of the set; thus 10 per cent. adjustment is available for equalising phases. They are immersed in a 5-ft. square wooden tank, and from fig. 6 it will be seen that none of the more effective lines of path are interrupted. This tank, only by varying the solution density, can be, and has been, used unaltered on voltages varying from 65 to 1,000, and on currents up to 2,000 amperes D.C., and 1,500 amperes per phase three-phase. A steam heater is provided which brings the temperature to 180° F. before starting, and so insures a rapid start and an immediate reaching of the boiling point, and thus a steady load. Washing soda, which is used as electrolyte, melts in its own water of crystallisation at about 86° F., and when added to water at the above temperature, disperses just as rapidly as a liquid substance would.

The authors of the Paper read at Birmingham state on authority that 50 gallons of cooling water are required per kilowatt-hour to keep the solution temperature within 70° F. of rise. Working on the high-resistance system on a 480-volt 125-KW. set, I have just managed to go six hours on a 600-gallon tank with a total water consumption of 76 gallons, added during the six hours, leaving the water level at the same point as when started. The temperature to commence with was 126° F., and at the finish 210° F. No soda was added during the test. In fact, the test was run on the remains of three handfuls of soda which were put in the tank about a fortnight previously. No cooling water was added at all for 3½ hours, by which time the water level had dropped 2 in. This was made up with 20 gallons of pure water; 36 gallons were added 1½ hours later, and a final 20 gallons at the end of the six hours, to bring the level to the starting point. This quantity of water works out at one-tenth of a gallon per kilowatt-hour. On the other system the total water consumption for the same load and time should have been 37,500 gallons.

Washing soda in a test tank becomes eventually sodium hydrate, which, having a higher conductivity than washing soda, keeps the load constant, or even tends to raise it slightly during a test; this happens, of course, if there is not any excessive leakage or splashing. I may say that even when the water was ½ in. from the edge of the tank the boiling, which was mainly confined to the centre, did not agitate the solution sufficiently to cause it to overflow at all. This very low water consumption tends, I think, to show that a very large proportion of the power is dissipated not as heat but in chemical action, principally in the electrolysis of water, for the total heat equivalent of the power dissipated is much greater than the equivalent of the water evaporated. Working at 212° F. does not cause excessive waste of plates. Very little waste takes place on iron plates if the current is kept less than 1 ampere per sq. in. of contact surface. In one case three wrought-iron plates weighing 90 lb. each lost 1 lb. each during 14 months of heavy working.

In the conversion of washing soda carbonic acid gas is set free. If the plate area is too small, carbon gathers on the negative plate and the positive plate becomes oxidised; but very little of this occurs even at 212° F. if the plate area is large enough. Another fault of the low-resistance fluid and long tank is that the wood is affected by the current, sodium nitrate among other things being formed. If this becomes to any extent formed in the wood it will cause the sparking and smouldering usually got when sodium or potassium nitrate is about, which means rapid destruction of the wood. With the three-plate high-resistance-solution system the wood can be kept almost entirely away from the influence of current; any diverging lines which are intercepted are those of very little effect. Plates should never come nearer the sides of the tank than about three times the shortest distance between the plates themselves.

MATHEMATICS FOR ENGINEERS.

Two papers, "The Teaching of Mathematics for Engineers" and "The Point of View in Teaching Engineering Mathematics," were recently read at Chicago before the American Association for the Advancement of Science, and excited considerable interest. Though there is nothing specially new in either, a summary of each may be of interest, if only to show that our American cousins are no more advanced toward a solution of the problem than we are ourselves.

Mr. Chas. F. Scott, the author of the former paper, approaches the question by a consideration of the work to be done by young men now taking engineering courses. He finds that only a few of them will be designers and original investigators; that, indeed, the great majority will require nothing, in their future career, but the ordinary rules of arithmetic. He cites the fact that a recent classification of the graduates of Sibley College, Cornell University, showed that about half were in occupations that required no advanced mathematics.

With reference to the kind of mathematics an engineer needs, we read:—"In general a great deal of engineering work is done with much less use of higher mathematics than most professors probably imagine, and further, it may be remarked, with much less than could be profitably employed. Engineers are apt to use ordinarily the mathematical methods with which they are most familiar, and which will bring the results with the least effort. One man employs calculus, another draws a diagram, another writes out formulæ, while another gets his results by mental arithmetic. The object

is to get the result." Skill in the *use* of mathematics is insisted upon as being the essential thing. The pure mathematician delights in the *relations* of natural phenomena, but the engineer is concerned with the natural phenomena themselves.

The author thinks that an engineer who uses logarithms "has no more concern regarding their derivation, than the ordinary user of the dictionary for finding the pronunciation of words has in their etymological derivation," and he brings forward the obvious truism that the ability to state a problem, to recognise the elements which enter into it, to know its physical significance, to understand what changes in original conditions may change a bad result into one which is practical and efficient, and so on, is of a higher order than the ability to take a stated problem and work out the solution.

Mr. R. S. Woodward, in the second paper, is inclined to think that the author of the first has taken himself too seriously. He states that the fundamental concepts of natural phenomena are much more difficult to understand than is usually supposed, and that if more time were given to the teaching of these, there would be less heard of the difficulty of applying mathematics. He instances the case of a candidate for a higher degree in mathematical physics who had studied mechanics and had attained a degree in engineering, but who, when asked the question, "What makes the trolley car run after the current is cut off?" replied, "It is the force of the momentum of the power of the energy of the car."

Another man, who had been a pupil of Lord Kelvin and Rankine, wrote a letter, in which he sought to convince the author that Newton and his followers were all wrong with regard to the parallelogram of impulses. "Thus," he said in his letter, "if a particle start out from a given point under the simultaneous action of two impulses, it will not move in the parallelogram of the impulses, but it will move in a tautochronous, brachistochronic plane catenary curve of a resilient character."

The author comes to the conclusion, after thus observing how difficult it is to master the fundamental ideas which belong to a great science, that "we may well consider the desirability of printing mathematical books free from demonstrations and containing plain statements of facts."

An analysis of these papers gives very little that is helpful. The truth is that the subject is one requiring most careful thought from those competent to judge. We have in our own country two great classes of engineering students, the university student and the evening technical school student. The former is a young man who can afford to attend a somewhat expensive course of three years or more, and it is reasonable to suppose that his training previously to entering the university has been sound; that, in fact, he has received a very fair knowledge of pure mathematics at a secondary school. When he enters the University, he is compelled to take a considerable further amount of the same subject in the classes presided over by the professor of pure mathematics, and at the same time he learns in the purely engineering classes how to turn his mathematical knowledge to the best advantage; what approximations to use, what degrees of accuracy to work to, and so on.

On the other hand, the student of the artisan class can only attend *evening* courses in a technical school. His previous mathematical training is usually nil, and the case is a difficult one. Unfortunately, the methods at present in use for his enlightenment are fundamentally unsound, for he is taught "practical mathematics" by teachers who, in the majority of cases, are not practical men—who, in fact, more often than not, have never been inside an engineering workshop.

It is a difficult matter to make suggestions, but perhaps the following system, if adhered to, will give the most satisfactory results:—

1. All engineering students should go through a preparatory course of pure mathematics, consisting of algebra up to the binomial theorem, trigonometry up to the solution of plane triangles, and the first three books of Euclid. During this course, no practical application should be given, and the subject should be taken for what it is, namely, a fundamental course of pure mathematics only.

2. Applied mathematics should be commenced: the use of approximations, four-figure logarithms, the slide-rule, the planimeter, the micrometer, squared-paper work, &c.

3. Laboratory work should follow. The student now begins to use his mathematics as tools, to get at the shortest methods of doing things, to conceive that his former training enables him to give proper meanings to engineering results, to pick out the fundamentals in a complicated formula, and to see that allowances have to be made for the imperfections of nature.

4. The study of higher mathematics may begin. The calculus should be treated in the pure mathematical way at first, and on no account be tackled in the applied way. There are numerous books on the "Calculus for Engineers," but they are one and all a delusion and a snare, and it is nearly impossible for a student approaching the subject for the first time to obtain any good from them.

TARIFF ALTERATIONS.

By E. E. HOADLEY.

In the year 1892, when the author first had anything to do with the public supply of electrical energy for lighting purposes, meters were looked on as very great luxuries, and things not to be trusted to work outside the station test-room. In those days it was not customary to give a supply over the whole 24 hours; a good many of the existing stations, particularly in the country, gave a high-tension alternating supply, and the rules were that the plant should be started up at times varying from 1 or 2 p.m. in the winter to 6 or 7 p.m. in the summer, and shut down about 1 a.m., while in the winter months an additional supply was usually given between the hours of 6 and 9 a.m. Under these conditions the usual way of charging was simply to make the consumer pay a fixed rate per annum for each lamp on his premises, so much for an 8-c.p. lamp, so much for a 16, and so on, and an amount calculated *pro rata* for each arc lamp, if a consumer could be found bold enough to install these latter. This arrangement, while open to the objections of being very primitive, and not differentiating between the good and bad consumer—considered from the point of view of the central station, had a merit which, from experience in recent years, has proved to be quite an important one, namely, that there was never any dispute as to the correctness or otherwise of the account when rendered at the end of the quarter. In times of bad trade it was not then the custom for 10 or 15 per cent. of the business class of consumers to wait till they were being pressed before paying their accounts, and then complain that the meters were all wrong. It is hardly appreciated now, when we are so used to it, what an amount of money is spent in buying meters, connecting them up, taking them out, recalibrating them every three or four years, to say nothing of testing and other time spent on them every time the consumer takes it into his head that his electric lighting account is bigger than he thought it was going to be.

In those early days, when the carbon-filament lamp, generally with platinum loops, was sold retail for 5s., there was very little inducement for the consumer to use his lights when they were not required, as the cost of lamp renewals was sufficiently high to act as a deterrent, and in those days, particularly out of London, practically everything in connection with the supply was obtained and done by the central station authority.

Recent innovations have given to us engineers food for serious thought and reflection as to whether the practically universal rule of charging by meter is the best that can be devised. By best the author intends to convey not that which is theoretically soundest, but that which will appeal in the most forcible manner to the consumers, and would-be consumers, whom he has to supply. That a fixed charge appeals directly to business men is an established fact, which is borne out by the author's experience in Maidstone, and by that of Mr. Seabrook, of West Ham. On many occasions on which consumers have grumbled at an account, the author has offered them arc lamps at a fixed rate per hour, and

although this is exactly the same as if they paid through a meter, the author has not yet met with a case where a man has grumbled at an account rendered in this manner; one point in its favour is that the average consumer thinks that he has just as much check on an account as the central station authorities have.

The foregoing is in the nature of an introduction to a subject which the author has very carefully considered for some time, and which daily impresses itself more and more on his mind as an idea which, at the very lowest estimate, is certainly worth while putting into practice, if possible in several towns, with a view to seeing whether under a new system of charging, based on what, for want of a better term, may be called broader and more or less businesslike lines, the supply of electricity for lighting purposes may not be advanced by such great strides that it will rival the increase in gas lighting.

Metallic filament lamps are the articles which it is earnestly hoped and strongly believed will be the wonder workers for the electricity supply authorities. They have been extensively boomed, and have now been in use for a sufficient length of time for it to be shown that they are practicable commercial articles. They are being rapidly improved, and from several sources one can obtain what is wanted very nearly as badly as anything can be wanted, *i.e.*, a high-voltage metallic lamp. Now, having got the lamp, it remains with the supply authority to make the most of it, and it is the author's firm belief that, if the problem of the best means of charging under the new conditions which arrive with the introduction of this lamp is tackled in the right spirit, enormous benefits will accrue. But in order to obtain the best results it is, in the author's opinion, absolutely essential that all supply station authorities should have equal powers with gas companies in the matter of supplying wiring and fittings, not doing the work themselves perhaps, but acting, as Mr. Edgcombe has put it, as their consumers' bankers. At the present time it is at least hoped that things are now proceeding on the right lines to bring about the desired results in this matter, which is of such importance to the suppliers of electricity.

Assuming that metallic filament lamps of the right voltage can be obtained, giving an English standard candle-power for about $1\frac{1}{4}$ watts, it means that the cost of lighting a consumer's premises with these lamps will be at least halved, even when taking into consideration the cost of lamp renewals; this is comparing metallic filament lamps with ordinary carbon lamps taking about 3·75 watts per C.P. Much has been said and written lately about the diminution in revenue likely to be felt, particularly by those supply authorities in non-manufacturing towns where the principal revenue is derived from lighting. In the author's opinion, there will not be any very drastic change for the next few years in the methods of charging to the large majority of the consumers of an average central station, where every consumer should have the option of being charged by meter on one of the many systems in use. But there are, as one must admit, enormous fields for the sale of energy for lighting purposes hitherto practically untouched. There are many towns in which the small shops in the least important streets are practically entirely gas lighted, and there are numberless small houses where electricity would be used but for the two drawbacks which have hitherto proved fatal to its adoption. These drawbacks are well known, and are, firstly, the initial cost of wiring, and secondly, the real or fancied excess cost of electric lighting over gas lighting. For years the author has devoted himself to the solution of the problem of electric lighting for small houses and shops with, he is the first to confess, only a limited amount of success, the chief reason being, after the wiring difficulty has been solved, the fact that a gas mantle will light a small sitting room a good deal better than a single 16 C.P. lamp. For these small houses and shops the author would strongly recommend that the living rooms be wired absolutely free of any initial expense, but the bedrooms only on payment of a certain sum per point, either by the landlord or tenant, as careful records which have been kept for a number of houses, have proved that bedroom wiring is very unremunerative, when the cost has to be defrayed in some form or other by the amount of energy used by the lamps in these rooms. Metallic filament lamps taking either 60 or 35 watts, as the size of the room demands, should be used and a certain fixed charge, calculated weekly or monthly, made for the use of the light. As a check against extravagance, sealed lamp-holders such as have been used by Mr. R. P. Wilson could be adopted, and the tenant would have to pay for lamp renewals, such lamps being obtained either from the central station or from a contractor. Electric lighting used in this class of property is extremely remunerative, as figures obtained by the author of units used and maximum demand, assure him that there are few better consumers from the central station point of view than this small property. Although slot meters have been considerably reduced in price, and have increased in reliability, there are many towns where the cost of meters and their upkeep does away with most of the profit obtained from the relatively small number of units used in each installation of this class.

For existing consumers an additional method of charging could be given under the same conditions of so much per lamp per quarter, the quarterly charge being either a quarter of the annual charge, or differentiated according to either a summer or winter load; but, in the author's view, the most important point is that the charge per lamp should be a differential one, *i.e.*, there should be so much per annum for shop window lamps, so much per annum for inside lamps, so much per annum for lamps used in dwelling houses, either striking an average throughout the house or having different prices for bedroom and sitting-room lamps. The same arrangements for lamp renewals, to prevent waste, could be arranged for in this case, but if the consumer signed a small agreement, one clause of which was that he should only use metallic filament lamps, the existing price of these would, the author thinks, be sufficient to deter him from using his lamps unnecessarily. From conversations with a large number of tradesmen and others, there is this much to be said for the proposed arrangement, that whatever may be the objections raised by those responsible for the supply of electrical energy, much still remains to be said in favour of it by those at the other end of the line who are responsible for the use of electrical energy, and from whom the wherewithal to keep the station running is drawn. At any rate, the author is convinced for his own part that there is so much in favour of it that it is at least worth a trial, and he hopes that more than one supply authority may be induced to give it such a trial in order that its merits and demerits may be thoroughly tested under as many different conditions as possible.

REVIEWS.

Electric Power Transmission. By Louis Bell, Ph.D. Fifth edition. London: Archibald Constable & Co., Ltd. 1908. Price 16s. net.

The popularity of this essentially practical treatise on electric power transmission is testified by the rapid appearance of the present edition—the fifth since the work was first published in 1897. The fundamental facts of present-day practice in this branch of electrical engineering are very ably stated and explained. Although no book can take the place of actual experience, those engaged on the solution of the problems connected with the economical transmission of power electrically will derive material benefit and sound guidance from a study of this book, the value of which is guaranteed by the name of its author.

There are 18 chapters, of which the first, under the heading "Elementary Principles," deals with the fundamental conceptions of energy in its various forms, the electric charge and electric current from the standpoint of energy, the principles underlying the transformation of mechanical into electrical energy, the usual elementary conceptions of dynamos and alternators, the measurement of electrical energy, and electrical units. On page 21 of this

chapter the following statement is not quite correct and "power" should be substituted for "energy":—"So the number of volts multiplied by the number of amperes is numerically equal to the water—*i.e.*, we have obtained the dynamical equivalent of the two factors that make up electrical *energy* (the italics are ours) as ordinarily reckoned." A similar mistake occurs in the opening paragraphs of Chapter XVII. We mention this to emphasise the importance of strictly adhering to a sharp differentiation between electrical power and electrical energy.

In Chapter II—General Conditions of Power Transmission—the utilisation of the various sources of energy is first discussed, and the possibilities of the two most important ones—fuel and water-power—are then more closely investigated. Next follow a very able and critical account of the distinctive characteristics of electric transmission, wire-rope, hydraulic, compressed-air and gas transmission, their advantages and limitations, and the consideration of the features of the problems of power transmission usually met with in practice, comparative estimates of the various kinds of transmission being also included.

Chapter III is on power transmission by continuous currents. After considering in a broad way the cases in which power transmission is met by the application of continuous current, the special modifications of dynamos and motors are investigated in a concise and practical manner, together with their particular applications and characteristic properties. Then power transmission at constant current is critically discussed, with explanations of some typical installations on this principle, and the chapter terminates with sections devoted to power transmission at constant pressure, systems with interdependent dynamos and motors, and a survey of constant-pressure systems.

The properties of alternating currents are next examined and explained in Chapter IV. The discussion is non-mathematical, is highly readable and instructive, and will be appreciated by a good many who use the book.

Chapter V deals with power transmission by alternating currents. Starting with some introductory notes the constructional details, wave form, efficiency and modifications for power purposes of alternators are given in considerable detail. Single-phase, two and three-phase transformers are then considered in the same exhaustive manner.

Chapter VI is on alternating-current motors. In the first portion the characteristics, advantages and disadvantages of synchronous motors are clearly set forth, and the effect of under and over excitation, and the general character of hunting explained. In the remainder, which is much the larger of the two sections, the features of induction motors are excellently portrayed, and simply explained from a practical standpoint. The chapter contains a number of illustrations, diagrams and performance curves of representative American machines.

It terminates with some interesting remarks on the relative importance of the different A.C. systems, and the choice of frequency. On page 274, in the explanation of the terms used in the formula giving the relation between the static and running torques of an induction motor, the static and running currents and the slip, viz., $\frac{T}{T_s} = S\frac{C^2}{C_s^2}$, we find some evident slips. T denotes the static torque, not T_s as stated, and C is the static current, not C_s; S is the slip expressed as percentage, and T_s and C_s denote the torque and current of the slip, *i.e.*, the full-load running torque and current per phase, as given in the book. An example shows the correct application of the formula.

Under the heading "Current Reorganisers," commutators, motor-generators, rotary converters, rectifiers and permutators are dealt with in the following chapter. Chapter VIII is one of a general character on engines and boilers. The main features and essential facts of the various classes of engines, boilers and steam turbines are well outlined, and their usefulness and limitations pointed out from the point of view of commercial power transmission. Water-wheels are dealt with on similar lines in Chapter IX, in which the characteristics of the different types of turbines and water-wheels are well set forth, the regulation of water-wheels being very clearly discussed in the second half of this chapter, with excellent prints and diagrams.

In Chapter X, under the heading "Hydraulic Development," most useful information is given on the development of natural falls, the survey work to be undertaken in planning out a hydro-electric scheme, methods of measuring flow, &c., with excellent examples of dam construction in America. Pipe line construction is explained and illustrated, and the points relating to the available market and possible demand for electrical energy are worthy of attention. On page 404 fig. 228 should read fig. 227.

The many questions of the organisation of a power station are next very ably discussed in Chapter XI, which also contains a series of illustrations of typical hydro-electric installations, and in which will be found many useful practical hints. The auxiliary and switchboard apparatus employed in the generating and sub-stations are suitably dealt with in Chapter XII.

Chapter XIII—The Line—is a very important one, and summarises all the salient features of this part of the problem in a highly satisfactory manner. The consideration of the question is divided under three main heads—the line as conductor, as a special problem in engineering, and as a mechanical structure. The author then discusses the proper voltage to be used, and the line loss in four typical cases which occur in American practice, giving excellent advice as to methods of procedure. The relative properties of metals and alloys as conductors for the line, loss of current to earth, insulation of aerial conductors, insulators, sparking distance, and insulating materials, are discussed. The special difficulties to be met with in working with alternating current—inductance and capacity—together with the necessary formulæ involved in line calculation are explained. Electrical resonance and surging are also well treated, and the chapter terminates with a review of the factors that enter into the design of a transmission line.

Line construction is given in the next chapter, which opens with a well-balanced consideration of the route to be followed, the difficulties to be overcome and how to meet them. The line wire is next considered in some detail—span, sag, tension, &c.—and then follow useful information and data *re* poles. Examples of special line and tower construction are included, together with notes on the question of lightning, lightning arresters, insulators, telephone lines and repairs.

The subject of distributing the electrical energy after it has been received from the transmission lines is treated in Chapter XV—Methods of Distribution—under the headings: distribution direct from the transmission system without special reducing transformers, or sub-stations, distribution from scattered sub-stations, and distribution from a main reducing station. The chapter also includes notes on arc lamps, carbon and metal filament and Nernst incandescent lamps and motor circuits. The whole question of distribution is exhaustively dealt with, and several American systems are illustrated.

In Chapter XVI—The Commercial Problem—the various factors which bear on the possible commercial success of an undertaking are investigated, and the items of cost separately gone into. The subject is well handled.

The measurement of electrical energy is explained, and the instruments used are described and illustrated in Chapter XVII. The final chapter contains a summary of the progress made in high-voltage transmission. Present tendencies are discussed, and recent innovations pointed out. The general aspect is reviewed, and the chapter terminates with a list of American operating at 20,000 volts and above.

The book is well illustrated, is furnished with a good index and contains a number of useful tables.

The Law of Patents, Designs and Trade Marks. London: Cruikshank & Fairweather, Ltd. International Patent Agency, 65, Chancery Lane, W.C.

Inventions: How to Protect, Sell and Buy Them. By Frederic B. Wright, Attorney-at-Law, Counsellor in Patent Causes. New York: Spon & Chamberlain; London: E. & F. N. Spon, Ltd. Price 1s. 6d. net.

Of the making of books on patent law there would seem to be no end! The recent important changes in this branch of English law undoubtedly made a call for fresh commentaries, and authors have not been slow to answer the call.

In the first of the volumes under notice, the object of the publishers is, primarily, to provide an adequate reply to those inquiries which are addressed to a patent agent by inventors and others from day to day. The book is intended as a business man's guide to the law of industrial property, and touches on matters of history, industrial or political, only where historical considerations are of practical importance in the interpretation of the law as it now stands.

These, according to the preface, are among the objects of the work before us. It is also pointed out in the preface that the authors "Undertake the duties of advisers in all matters connected with the maintenance and revocation of patents, the conduct of opposition cases, and actions for infringement of patents," &c. The subject matter consists of two parts, of which Part I is sub-divided into The British Patent System; The Law of Design Copyright; and the Law of Trade Marks "Passing Off," "Merchandise Marks Acts," and "Copyright Registry." The second part deals with "Foreign and Colonial Patents." Under this head may be found short notes on the patent laws of foreign States and of the British Colonies. The work is concluded by a list of clients for whom the authors have had the privilege of acting. A good index of the subject matter would, in our view, have been more generally useful to the ordinary reader.

The second work above referred to, as the designation of the author implies, is an outline of the patent laws of the United States. To the British patentee, who is anxious to protect his rights in America, this little book ought to prove very useful. There is a certain terseness about the American patent law which is rather attractive. Instance the question of "novelty," which, in the United States, as in this country, is an essential ingredient for a valid patent. The requirements under the head of novelty are: "That the invention shall not have been known before conception; that it shall not be obvious, and that it shall not have been given to the public after its invention." The author sets out in one place a sample specification of a "new and useful wave-power," to which he has annexed the proper diagrams. A study of this specification ought to give the British inventor some idea how to protect himself in America.

Electricity. What is it? By W. Denham Verschoyle. London: Swan, Sonnenschein & Co. Price 2s. 6d. net.

In his preface the author states, "there may be a line which contains the germ of truth, and they are written because 'The highest truth a wise man sees he will fearlessly utter,' &c."

It seems to the reviewer that there is a very considerable difference between *truth* and what appears to the author of this treatise to be truth. If mere guesses or statements are made without a vestige of physical or experimental support doubtless they may be quite true, but the demonstration is lacking. Certainly the author of this work is speaking fearlessly, and, on the whole, the treatise is an interesting one.

There are nine chapters, dealing with the Gyron, the Evolution of the Atom, Numerical Relations of the Atom, the Molecule, Heat and Light, Electricity and Magnetism, Life, &c. The writer does not pretend to be able to follow the author and the various principles laid down, and the α, β and γ forces of the Gyron.

According to this author, there is no such thing as electricity—electricity is a "mode of motion." It is a motion of ether—a perfectly definite absolute motion of a certain volume of the ether.

All matter is to be supposed made up of little systems which are composed of gyrons, which again are only ether in motion. These, in turn, are supposed to be disks in rotation, and each of them gives rise to three distinct types of "ether motion":—

1. The alpha force generated by the lateral faces; (2) the beta force, by periphery; (3) the gamma force due to translational motion.

"The alpha motion is of a helicoidal or spiral form," and so on. On page 50 certain axioms are laid down, such as "a rotating body causes motion in the surrounding ether."

In the chapter on the numerical relations of the atom, the author deduces some very interesting results.

There are a few misprints: page 44, Thompson for Thomson; viscosity, page 21; Haeckle, page 215; Nacent state, page 183.

As a theory of the universe treated without mathematics, the treatise is doubtless interesting, but the reviewer finds it exceedingly difficult to follow, as no proofs or demonstrations are given.

FORMS FOR THE USE OF ELECTRICAL UNDERTAKERS.

By Our Legal Contributor.

(*Continued from page* 335.)

8. *Form of requisition to be served upon persons liable to repair highways, &c.*

No. .....

The ..... Electricity Supply Co., Ltd.

Requisition made pursuant to Sec. 16 of the *Schedule* to the Statute 63 and 64 Vict., c. 19.

To ....., being the person or persons liable to repair ..... Street [or being the owners of the tramway running through and along the streets of ..... and .....], or so much thereof as is situate within the district in which the above-named company are entitled to supply electricity.

Whereas, by a notice served upon us on the ..... day of ....., 190 , you stated that you desired to exercise or discharge all [or any part] of the powers therein specified in relation to the breaking up, filling in, reinstating and making good of ..... Street, within our district; and whereas you have, up to the date hereof, failed to exercise any of the said powers.

We hereby give you notice, in accordance with Sec. 16 (*b*) of the Schedule to the Electric Lighting (Clauses) Act, 1899 (63 and 64 Vict., c. 19) to commence the said works at or before ..... a.m. on the ..... day of ....., 190 . [The date here inserted should not be *more* than four or *less* than two days after the date of the requisition.]

And further take notice that, unless you comply with this requisition within twenty-four hours of the time before mentioned, the Company will themselves proceed to exercise the powers and duties specified in your said notice, in like manner as they might have done if such notice as aforesaid had not been given to them by you.

(Signed) .....

Dated this ..... day of ....., 190 .

9. *Form of notice to be served by Undertakers on the owners of pipes and lines which are likely to be interfered with during the laying of mains.*

No. .....

The ..... Electricity Supply Co., Ltd.

To .....

Take notice that, on the ..... day of ....., 190 , and in accordance with the 17th Sec. of the Schedule to the Electric Lighting (Clauses) Act, 1899, the Company intend to perform the following works in or near pipes [or wires] belonging to you or under your control, viz.:—

The position of the said works is indicated upon the plan [or plans] hereto annexed.

(Signed) .....

Dated this ..... day of ....., 190 .

10. *Form of notice under Sec.* 18 (1) *of the Schedule to the Electric Lighting (Clauses) Act*, 1899.

No. .....

The ..... Electricity Supply Co., Ltd.

To the Engineer of the ..... Waterworks.

Notice of laying electric lines near water pipes.

We hereby give you notice that, under the powers of our order and in accordance with Sec. 18 (1) of the Schedule to the Electric Lighting (Clauses) Act, 1899, incorporated with our order, we intend on the ..... day of ....., 190 , to commence laying down wires under or near your water pipes, in the street or road known as ....., in the borough of .....

Dated this ..... day of ..... 190 .

For the ..... Electricity Supply Co.

(Signed) .....

(*b*) *Notices and contracts relating to the supply of electricity.*

In their dealings with consumers, there are many notices which must from time to time be used by electricity supply companies and local authorities supplying electricity.

(1) *Form of notice to Telephone Company under Sec.* 20 (2) *of the Schedule to the Electric Lighting Clauses Act*, 1899.

No. .....

The ..... Electricity Supply Co., Ltd.

To the ..... Telephone Co., Ltd.

We hereby give you notice that, under the powers of our order and in accordance with Sec. 20 of the Schedule to the Electric Lighting (Clauses) Act, 1899, incorporated with our order, we intend on the .... day of ..... 190 [*mentioning some date 7 days after the date of this notice*], to commence laying down wires under or near your telephone wires, in the street known as ..... in the borough of .....

The following are particulars of the wires which we propose to lay down.

[*Here state (a) the course, nature and gauge of the intended line; (b) the amount and nature of the currents to be transmitted; (c) whether, and if so, what earth returns are to be used.*]

Dated this ..... day of ..... 190 .

For the ..... Electricity Supply Co.

(Signed) .....

(2) *Form of notice that pipes are about to be laid, under Sec.* 22 *of the Schedule to the Electric Lighting (Clauses) Act*, 1899.

No. .....

The ..... Electricity Supply Co., Ltd.

To the ..... Urban District Council [or other local authority] or to A. B., owner of No. 4, ... Street.

Whereas, by Sec. 22 of the *Schedule* to the Electric Lighting (Clauses) Act, 1899 (63 and 64 Vict., c. 19), it is provided as follows:— [*Here set out the section*]

We hereby give notice that we intend, on the ..... day of ....., 190 , to lay an electric line for the purpose of supplying energy to the occupier of .....

If, at any time before the expiration of 28 days from the service of this notice, you should desire to obtain a supply of electricity at your house, notice should at once be given to us.

For the ..... Electricity Supply Co.

(Signed) .....

Dated this ..... day of ....., 190 .

(3) *Form of notice demanding security under Sec.* 25 (1) *of the Schedule to the Electric Lighting (Clauses) Act*, 1899.

No. .....

The ..... Electricity Supply Co., Ltd.

To ..... [all and sundry the persons who have signed a requisition under Sec. 24 of the *Schedule* to the Electric Lighting (Clauses) Act, 1899]

Whereas, by a requisition dated the ..... day of ....., 190 , signed by you, we were requested to supply electricity to you at ....., upon the terms stated by you in the said requisition; and whereas, by the 25th Sec. of the *Schedule* to the Electric Lighting (Clauses) Act, 1899 (63 and 64 Vict., c. 19), we are empowered to demand security before supplying you with electricity,

We hereby give notice that we decline to supply electricity to you, or any of the persons who signed the requisition, unless you or some of the persons who signed the requisition will bind yourself or themselves to take, or will guarantee that there shall be taken, a supply of energy for a period of three years at the least, of at least [*Here state minimum amount*], to the end that the supply to you will produce the annual sum of at least £.....

[Note.—The sum specified must not (without the authority of the Board of Trade) amount to more than 20 per cent. of the expense of providing and laying down the required distributing mains, and any other mains or additions to existing mains which may be necessary for the purpose of connecting those distributing mains with the nearest available source of supply.]

And we give you further notice that unless, within fourteen days after the service of this notice upon you, you, or some of you, tender an agreement or give a guarantee to the effect aforesaid, or unless you give sufficient security for all the moneys which may become due to us under such agreement or in respect of the supply of electricity, we decline to supply you with electricity.

For the ..... Electricity Supply Co.

(Signed) .....

Not the least important of the notices and forms with which the supply company has to deal with from time to time, are those which deal with their relations with consumers. It is necessary that the notices received from and given to consumers from time to time, shall not only comply with statutory requirements, but that they shall be clear and explicit in their terms.

(4) *Form of application for supply.*

Vestry of .. .. [*or* the name of the supply company].

Electric Lighting.

Application for Supply.

To be filled up by the applicant and addressed to [*the secretary*], ... at .....

1. Situation of premises to be supplied with electric current. { ....
2. Total number of lamps to be fixed:—
   ..... of 8 c.p. each.
   ..... of 16 „ „
   ..... arc lamps.
3. Probable maximum demand calculated in 8-c.p. or 35-watt lamps .....
4. Date by which supply is required .....
5. Name and address of contractor wiring premises ....
6. This application is subject to the conditions contained in the agreement for the supply, which the applicant will be required to sign.

Dated this ..... day of ..... 190 .

Signature of applicant .....

Present address .....

In order to keep the terms of his contract well before the consumer, supply companies are in the habit of printing the foregoing application form on one side, and the conditions or rules for supply on the other side of the paper. In some cases the application for and agreement to take a supply, are embodied in the same document. Thus in one of the Urban Districts, within the administrative County of London, the application is in the following form:—

Received:— No. .....

..... Urban District Council [*or* the Company].

To the Electricity department .....

I (or We), the undersigned, hereby apply for a supply of electricity to the premises as mentioned below.

I (or We) append particulars of the supply required, and agree to take and pay for the same on the terms and conditions mentioned in the attached form.

Signature .....

Address .....

Date .....

[*Here follow particulars of the number of lamps required, probable maximum current required, and other details very similar to those which will be found in the application form which has already been considered.*]

A more approved method is followed in another metropolitan district. At the end of a printed document, which contains *Rules for Supply, and Regulations for Installation Work*, there appears an *Agreement for supply* in the following form:—

(5) *Form of Consumer's agreement.*

No. .....

Borough Council of .....

Electric Lighting.

Agreement for Supply.

I, the undersigned, Tom Jones, of 54, Blank Street, in the Parish of ....., in the County of London, hereby contract and agree with the Borough Council of ....., to receive and pay for the supply of electrical energy to the premises mentioned below, in accordance with the above rules for supply and regulations for installation work, and to continue for two years to receive and pay for at least ..... units per annum. And I agree to comply with the said rules and regulations, and with any revised or additional rules and regulations (subject to the provisions of the Provisional Order, under which the Borough Council are acting), which may be issued by the Borough Council, so far as they relate to or are performed by me.

Dated this ..... day of ..... 190 .

Signed .....

Premises to be supplied with electricity. { ....

(7) Charges for Electricity.

On the back of their application form it is often wise for the undertakers to set forth the terms upon which they grant a supply. The following terms are to be found in a form in actual use:—

(a) *For lighting.*

6d. per unit for the first hour's use per day during each three months of the maximum demand; and

2½d. per unit for all consumption during each three months beyond the hour's use per day; or

Alternatively, at the consumer's option, a flat rate of 5*l.* per unit.

Should a consumer (who is charged on the maximum-demand system) desire to make use, under exceptional circumstances, of more than the ordinary average number of lamps, he may on such occasions, but not exceeding once in each month, on giving 24 hours' notice to the electricity works, have the demand indicator temporarily disconnected, so that such exceptional use may not affect the normal maximum demand on which the primary charge is based.

(B) *Flat rates for special classes of consumers.*

(i) For private residences, where the entire lighting of the premises is done by electricity, a flat rate of 4d. per unit.

(ii) For licensed premises which do not close before 11 p.m. on week-days, and where the entire lighting of the premises is done by electricity, a flat rate of 3½d. per unit.

(iii) For theatres and music halls, a flat rate of 3½d. per unit; but concert halls and other similar places of amusement to remain at the present rate of 4d. per unit.

[NOTE.—With this class of consumers, these special flat rates do not apply in the cases of supply to temporary buildings, or to permanent buildings for temporary purposes.]

(iv) For newspaper offices in which are printed morning daily papers, a flat rate of 3½d. per unit for lighting, and 1¾d. per unit for motive power.

(v) For churches and buildings attached thereto, a flat rate of 4½d. per unit.

(C) *For motive power.*

4d. per unit for the first hour's use per day during each three months of the maximum demand, and

1d. per unit for all consumption during each three months beyond the one hour's use per day; or

Alternatively, at the consumer's option, a flat rate of 2½d. per unit.

(D) *Minimum charge.*

Each consumer will be required to pay a minimum charge of 10s. per quarter, notwithstanding that the value of the quantity of the energy supplied for any purpose whatsoever may have been less than 10s.

(E) *Hire of meters for lighting or motive power.*

The Company will charge the undermentioned rates for the hire of meters:—

Up to the equivalent of 50 lamps of 8 C.P., 2s. 6d. per quarter; from 50 lamps of 8 C.P., and not exceeding 100, 5s.; and exceeding 100 lamps, 7s. 6d.

(8) *Form of notice to disconnect.*

The ..... Electric Supply Co., Ltd.

[Works and Offices of the Company.]

..... day of ..... 190 .

Notice to Disconnect.

WE HEREBY GIVE YOU NOTICE under Sec. 21, of 53 and 54 Vict. c. 186, that unless the sum of ..... is within seven days from the date of service hereof given as security for the payment of all moneys which are and may from time to time become due in respect of the supply of electric energy, the Company may discontinue such supply, and will take action to recover all moneys due.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

17,281. "Improvements in and relating to electric furnaces." A. H. IMBERT. August 17th. (Complete.)

17,283. "Improvements in or relating to electric conductors." R. K. GRAY. August 17th.

17,291. "Improvements in high-tension electric switchgear." A. C. HEAP and P. W. BEATTY. August 17th.

17,308. "Improved apparatus for supplying and measuring electric current." W. D. WATSON and W. L. ASHWORTH. August 18th. (Complete.)

17,311. "Improvements in and relating to dynamo-electric machines." T. FERGUSON. August 18th.

17,315. "Improvements in or relating to electrical switches." H. W. COX. August 18th.

17,331. "Improvements in reversible galvanic batteries." H. C. HUBBELL and H. W. FULLER. August 18th. (Complete.)

17,349. "Improved apparatus for producing rapid electric oscillations." E. VON LEPEL. (Date applied for under Sec. 91 of the Act, August 20th, 1907, being date of application in Germany.) August 18th. (Complete.)

17,350. "Process for improving the ductility of tungsten." SIEMENS AND HALSKE AKT.-GES. (Date applied for under Sec. 91 of the Act, September 14th, 1907, being date of application in Germany.) August 18th. (Complete.)

17,355. "Improvements in and relating to electric accumulators." C. HAUNZ and P. SCHREIBER. August 18th.

17,380. "Improvements in and relating to dynamo-electric machines." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) August 18th.

17,395. "Improved method of supplying tramcars with power from electric cables." R. GLOVER. August 19th.

17,410. "Improvements in electric switches." A. P. LUNDBERG, G. C. LUNDBERG and P. A. LUNDBERG. August 19th. (Complete.)

17,412. "Improvements in insulating the live parts of electric switches and the like." SIEMENS BROS. DYNAMO WORKS, LTD., and E. G. NICHOLLS. August 19th.

17,414. "Improvements in ventilating the rotors of dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD., and E. O. KIEFFER. August 19th. (Complete.)

17,416. "Improvements in and relating to the cooling of the end windings of dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens-Schuckertwerke G.m.b.H., Germany.) August 19th. (Complete.)

17,417. "Improvement in or relating to commutators for electrical machinery." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens-Schuckertwerke G.m.b.H., Germany.) August 19th. (Complete.)

17,419. "Improvements in arc lamp electrodes." G. M. LITTLE. (Date applied for under Sec. 91 of the Act, September 3rd, 1907, being date of application in United States.) August 19th. (Complete.)

17,421. "Improvements relating to electric arc lamps." KÖRTING and MATHESEN AKT.-GES. (Date applied for under Sec. 91 of the Act, August 20th, 1907, being date of application in Germany.) August 19th. (Complete.)

17,481. "Improvements in electric primary and secondary cells." R. SOWINSKI. August 19th.

17,485. "Improvements in or connected with secondary batteries." A. P. STROHMENGER. August 19th.

17,498. "Manufacture of objects of tungsten or of alloys thereof." SIEMENS AND HALSKE AKT.-GES. (Date applied for under Sec. 91 of the Act, September 26th, 1907, being date of application in Germany.) August 19th. (Complete.)

17,499. "Improvements in apparatus for electric telegraphs." A. T. BLACKALL and C. M. JACOBS. August 19th.

17,456. "Improvements in or relating to insulating and gripping devices for electric conductors." O. GRAETZER. (Date applied for under Rule 13, October 28th, 1907. An invention comprised in Application No. 23,774, dated October 28th, 1907.) August 19th. (Complete.)

17,461. "Improvements in or relating to ironclad electric switches and switch fuses." V. HOPE. August 20th.

17,475. "Disinfectant telephone transmitter." H. R. SOAR. August 20th.

17,493. "Improvements in insulated joints for railway rails and the like." B. WOLHAUPTER. August 20th.

17,505. "Improvements in apparatus for wireless telegraphy." G. MARCONI and MARCONI'S WIRELESS TELEGRAPH CO., LTD. August 20th.

17,509. "Improved arc lamp." REGINA-BOGENLAMPENFABRIK G.m.b.H. and P. HANISCH. August 20th. (Complete.)

17,511. "Improved electric conduit junction boxes." W. SCHMAHL. August 20th. (Complete.)

17,512. "Electrical conduit junction boxes for electrical outlet fittings such as switches, wall plugs and the like." W. SCHMAHL and A. R. HENDERSON. August 20th. (Complete.)

17,527. "Improvements in and connected with magnetic blow-outs for lamps." A. ZOLLER. August 20th.

17,530. "Improvements in and relating to electric cables." LAND-UND SEEKABELWERKE AKT.-GES. (Date applied for under Sec. 91 of the Act, September 7th, 1907, being date of application in Germany.) August 20th. (Complete.)

17,531. "Improvements in and relating to telephone transmitters and receivers." F. SCHILLING. August 20th. (Complete.)

17,533. "Improvements in electrical accumulators." P. L. TRIN. (Date applied for under Sec. 91 of the Act, August 29th, 1907, being date of application in France.) August 20th. (Complete.)

17,535. "Improvements in and relating to arc lamps." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Sec. 91 of the Act, August 21st, 1907, being date of application in Germany.) August 20th. (Complete.)

17,536. "Improvements in controller mechanism for electrically operated cranes, lifts and the like." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Sec. 91 of the Act, August 21st, 1907, being date of application in Germany.) August 20th. (Complete.)

17,540. "Light-controlled lighting switch." SIR H. NORMAN and T. B. READER. August 21st. (Complete.)

17,562. "Combined terminal and cord grip used for electric light lamp-holders." E. PHILLIPS. August 21st.

17,588. "Improvements relating to the electro-deposition of metals and alloys." J. H. S. BRADLEY and L. W. JENKINS. August 21st.

17,607. "Improvements in electric plug switches." J. ZEITLIN. August 21st.

17,610. "Process for improving the ductility of tungsten." SIEMENS AND HALSKE AKTIEN-GESELLSCHAFT. (Date applied for under Sec. 91 of the Act, September 26th, 1907, being date of application in Germany. Application for Patent of Addition to No. 17,350, 1908.) August 21st. (Complete.)

17,611. "Process for improving the ductility of tungsten." SIEMENS AND HALSKE AKTIEN-GESELLSCHAFT. (Date applied for under Sec. 91 of the Act, December 9th, 1907, being date of application in Germany. Application for Patent of Addition to No. 17,350, 1908.) August 21st. (Complete.)

17,612. "Improvements in and relating to means for the constant disinfection of speaking tubes, telephone mouth-pieces or the like." G. W. GIBBERD and O. A. ELIAS. August 21st. (Complete.)

17,618. "Improvements in and relating to the manufacture of refractory conductors." W. C. ARSEM. (Date applied for under Sec. 91 of the Act, August 24th, 1907, being date of application in United States.) August 21st. (Complete.)

17,619. "Improvements in and relating to the manufacture of refractory electric conductors." C. T. FULLER. (Date applied for under Sec. 91 of the Act, August 24th, 1907, being date of application in United States.) August 21st. (Complete.)

17,620. "Improvements in and relating to the manufacture of refractory electric conductors." W. D. COOLIDGE. (Date applied for under Sec. 91 of the Act, August 24th, 1907, being date of application in United States.) August 21st. (Complete.)

17,621. "Improvements in and relating to the manufacture of refractory electric conductors." W. D. COOLIDGE. (Date applied for under Sec. 91 of the Act, August 24th, 1907, being date of application in the United States.) August 21st. (Complete.)

17,622. "Improvements in and relating to electrically-operated cranes, lifts and the like." ALLGEMEINE ELEKTRICITATS GES. (Date applied for under Sec. 91 of the Act, August 23rd, 1907, being date of application in Germany. August 21st. (Complete.)

17,626. "Electric light fitting." G. W. DE TUNZELMANN. August 22nd.

17,627. "Improved electric ignition device or sparking plug." THE SILICA SYNDICATE, LTD., and P. ST. CLAIR MATTHEY. August 22nd.

17,659. "Improvements in insulating materials for electrical purposes and the like." S. H. H. BARRATT. August 22nd.

17,667. "Improvements in electric heating apparatus." R. G. PHEYSEY. (Date applied for under Sec. 91 of the Act, August 22nd, 1907, being date of application in United States.) August 22nd. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1907.

TREMBLERS OF INDUCTION COILS. B. Brooks and F. H. Alston. 20,361 September 12th.

DEVICE FOR CLEANING OR TRUEING ELECTRIC CONTACTS. J. A. Haslop. 20,460. September 13th.